

EXAMINATION OF COLORADO WATER LEGISLATION, ITS ISSUES,  
PROGRAMS, AND THEIR RELATIONSHIPS: 1931 TO 2006

By

Samuel Ballou Gallaher

B.S., Oregon State University, 2004

A thesis submitted to the  
University of Colorado Denver  
In partial fulfillment  
of the requirements for the degree of  
Master of Public Administration

2011

This thesis for the Master of Public Administration

degree by

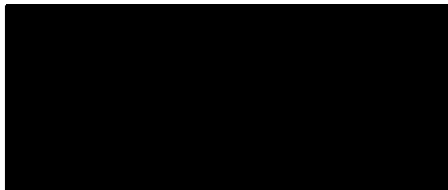
Samuel Ballou Gallaher

has been approved

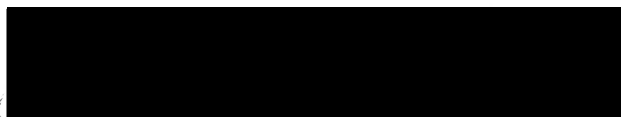
by



Tanya Heikkila



Christopher Weible



Edella Schlager

4-27-11

Date



Gallaher, Samuel Ballou (M.P.A., School of Public Affairs)

Examination of Colorado Water Legislation, its Issues, Programs, and Their Relationships: 1931 to 2006

Thesis directed by Associate Professor Tanya Heikkila

### ABSTRACT

This thesis describes how water laws' issues and tools passed by the Colorado State Legislature changed between 1931 and 2006. Data was provided through previous work accomplished by Dr. Schlager and Dr. Heikkila under a National Science Foundation grant. The data were analyzed through multiple time scales: era, decade, and year. The number of laws passed, the issues they addressed, and policy tools used were described by graphical representation, descriptive statistics, correlation tests, and individual t-tests. The Advocacy Coalition Framework, punctuated-equilibrium theory and tool choice literature were used to inspire five propositions to address the research question "How do state water laws in Colorado change over time with respect to the laws' addressed issues and policy tools". Findings indicate the number of policy issues addressed and policy tools used increased over time. Furthermore, a particular issue was addressed by a growing and different variety of tools over time. Through era analysis of policy tools and issues, indication of tool preference by regime is shown. Analyses indicate a strong oscillation between the percent number of laws that addressed authority and allocation issues over all time periods. This oscillation and individual t-test of the number of laws passed per year for a given era indicate the legislature is both limited and growing in its capacity to address water policy issues over time.

This abstract accurately represents the content of the candidate's thesis. I recommend it publication.

Signed



Tanya Heikkila

## DEDICATION

I dedicate this paper to God, my parents, and life-long Scout friends; without whom, I would be a much worse version of who I am today and never strive to be better or have the courage to take the path with more resistance.

As I am writing about the historical waves in Colorado water policy, Japan is being devastated by real ones. While these words and this paper will not have an impact on them, I add those who lost their lives in the earthquake, tsunami, and nuclear emergencies and those aiding in recovery to the dedication.

Finally, to my classmate and friend Hilary who's degree was interrupted by health problems. I hope she heels quickly and returns soon.

## ACKNOWLEDGEMENT

I give heartfelt thanks to my advisors, Tanya Heikkila and Chris Weible, for their constant support and hours of discussion. Their enthusiasm, understanding, and insights during the research and throughout the master's program thoroughly enriched my experience and education. I also want to thank Dr. Heikkila and the School of Public Affairs for the generous grant during the first portion of the project. To all the members of my committee, I thank them for their input, and thanks to Vanessa Frank and Will Paterson for their research and time as we waded through Colorado's water policy history. Finally, I thank my parents their grammatical edits and for being the 4<sup>th</sup> and 5<sup>th</sup> persons who will probably read this document from cover to cover.

## TABLE OF CONTENTS

LIST OF FIGURES .....	ix
LIST OF TABLES .....	x
<u>Chapter</u>	
1. Introduction: The Importance Of Understanding Colorado Water Policy .....	1
1.1 Water Policy Studies in Colorado .....	1
1.2 Scope And Importance Of The Analysis .....	2
2. Policy Change Theory, Policy Tool Selection, and Research Questions .....	4
2.1 Advocacy Coalition Framework.....	4
2.2 Punctuated Equilibrium Theory.....	6
2.3 Policy Tool Selection.....	8
2.4 Propositions.....	9
3. Colorado Water Policy Background.....	11
3.1 Colorado Water Policy: Issues, Values, and Prior Appropriation .....	11
3.2 Colorado's Basic Water Administration Structure .....	14
3.3 Colorado Water Policy Changes Over Time.....	16
Establishment Of The Prior Appropriate Doctrine (1850-1900s) .....	18
3.3.2 Shifting Focus (1900-1950s) .....	18
3.3.3 Redefining Boundaries (1950-1965) and Growing Conflicts (1965-1980s) .....	20
3.3.4 Cooperation among Conflict (1980s-2006) .....	22
3.4 Colorado River Compact of 1922 .....	23
3.5 The 1969 Water Rights and Determination Act .....	26
4. Methods of Analysis .....	31
4.1 Data Collection .....	31
4.2 Dataset Groups and Timeframes.....	35

4.3	Calculations .....	37
5.	Analysis of Non-Minor Water Laws in Colorado (1931 to 2006).....	39
5.1	Era Analysis of Laws, Issues, and Tools .....	39
5.1.1	Increasing Rate of Laws Over Time .....	39
5.1.2	Increasing Issues and Decreasing Attention to Allocation and Authority .....	39
5.1.3	Increasing Tool Use by Era.....	42
5.1.4	Relationship Between Policy Issues and Tools .....	45
5.1.5	Relationship Between Policy Issues and Primary Tools .....	49
5.2	Year to Year Fluctuation and Increase of Water Laws, Issues, and Tools .....	55
5.2.1	Increasing Regularity of Years with Passed Water Laws .....	55
5.2.2	Issues Fluctuate and Authority and Allocation Issues Compete .....	55
5.2.3	Tool Volatility and Emergence of New Primary Tools .....	57
5.3	Issue Oscillation, and Legislature Issue Capacity.....	59
5.3.1	Oscillations between Water Allocation and Authority Issues .....	59
5.3.2	Increasing Attention Capacity of Issues at the State Legislature .....	62
6.	Conclusions and Discussion.....	65
6.1	Issues Relating To Water Issues Will Shift Over Time .....	65
6.2	The Legislatures Limited Issue Capacity .....	65
6.3	The Legislature Increased Issue Capacity .....	66
6.4	Policy Tools Used By The Legislature Shift Over Time.....	66
6.5	Tools Used By The Legislature Increase In Variety .....	67
6.6	A Particular Issue Can Be Addressed By Different Tools .....	67
6.6	Discussion .....	68
6.7	Future Work .....	70
<u>Appendix</u>		
APPENDIX A .....		72

APPENDIX B .....	73
APPENDIX C .....	77
APPENDIX D .....	78
APPENDIX E .....	79
<u>Bibliography</u> .....	80

## LIST OF FIGURES

Figure 1. Water Laws Per Year .....	55
Figure 2. Water Allocation Percent By Year. ....	56
Figure 3. Authority Or Powers Of An Agency Or District Percent By Year. ....	56
Figure 4. Water Quality Percent By Year.....	56
Figure 5. Regulation Percent Use. ....	58
Figure 6. Enforcement Percent Use. ....	58
Figure 7. Public Works/Infrastructure Percent Use. ....	58
Figure 8. Three-Period Moving Average Of Authority And Allocation Issues By Year. ....	60
Figure 9. Cumulative Percent Of ‘Water Allocation’ And ‘Authority’ Issues By Year.....	61
Figure 10. Water Storage Percent By Year.....	77
Figure 11. Species Or Habitat Protection Percent By Year.....	77
Figure 12. Watershed Restoration or Enhancement Percent By Year. ....	77
Figure 13. Information and Planning Percent Use. ....	78
Figure 14. Property Rights Percent Use.....	78
Figure 15. Monitoring Percent Use. ....	78
Figure 16. Permits Percent Use. ....	78
Figure 17. Finance Percent Use. ....	78
Figure 18. Colorado Water Policy Venues And Relationship .....	79

## LIST OF TABLES

Table 1. Coded attributes .....	31
Table 2. List of policy issues from the codebook.....	33
Table 3. Tool category and description .....	34
Table 4. Water laws per decade and era.....	39
Table 5. Count and percent volume of water policy issues. ....	40
Table 6. Policy issue percent by era. ....	40
Table 7. Count and percent volume of all water policy tools and primary tools.....	42
Table 8. Policy tool (all tools) percent by era.....	43
Table 9. Policy tool (primary tools) percent by era.....	44
Table 10. Cross-tab analysis of issues and tools (all) by era.....	46
Table 11. Tools with significant, positive correlations to water issues in each era. ....	48
Table 12. Count of primary policy tool used with each issue across eras.....	50
Table 13. The first era which the issue and tool combination was observed .....	53
Table 14. Policy issue percent change by decade. ....	62
Table 15. Number of unique issues addressed per year by era.....	63



## **1. Introduction: The Importance Of Understanding Colorado Water Policy**

### **1.1 Water Policy Studies in Colorado**

Water policy in the West is extremely complicated (Bates et al 1993, 3). This is due to a number of attributes. First, rivers and watersheds span the political state and federal boundaries and therefore multiple jurisdictions are encompassed by the geography. Next, the western states gave rights to private individuals to use this very public resource to private ownership if the user could prove they put the water to 'beneficial use'. This doctrine invoked tense interactions between individual, regional, state, federal and international peoples and between those institutions used to address cross-boundary issues (Hundley 1986, 14-16 and Bates 1993, 116). Finally, from the time the West was segmented into states and included in the Union to today, our cultural values have shifted (Bates 1993, 179 and Getches 1986, 69). In recent years emerging values have risen to the surface that reflect a better understanding of the environment and ecosystems and the wish to preserve natural resources for our future generations (Pontius 1997, S-i) re-defined problems associated with a growing population, industry, agriculture, and pollution (Grigg 2003 97).

Colorado is at the heart of many of the western and southwestern water related issues of the west because it is a headwater state. The use and management of water in California, Arizona, Nevada, Utah to name a few, directly impact and are impacted by Colorado's water management decisions (Hundley 1986, 9 and 14-35). Today, Colorado's policies are derived from and implemented by the state legislature, divisional water courts, the state engineer, water conservation boards, water districts and groundwater districts, interstate compacts, the federal government, and in extreme cases, the Colorado and U.S. Supreme Courts (Corbridge and Rice 1999). The state legislature is an integral part. The laws passed by the legislature connect federal, interstate compact, state constitution and

court decisions with the administration system. The legislature created the administration framework for local control; it devolved authority by creating water districts, conservation boards, and empowered the state engineer to act at the local level (Corbridge and Rice 1999, 142-220). The legislature creates and funds tools that solve conflict which could not be settled locally (Cech 2010, 310). Because of their central role in water policy development in Colorado, this analysis examines only water related laws passed by the State Legislature of Colorado.

## **1.2 Scope And Importance Of The Analysis**

The study will analyze the policy issues and policy tools addressed in Colorado state legislation from 1931-2006 as coded by a previous group of researchers led by Tanya Heikkila and Edella Schlager through a National Science Foundation Grant. Each law in the data set was coded for the policy issue addressed, the policy tools utilized, and the primary policy tool of the law. The analysis will show that the utilization of data by era, decade, and yearly give both the 'forest' interpretation and 'tree' examination, which allows us to understand themes over a large period of time and year-to-year nuances within large sets of information. The themes of policy issues and policy tools examined through the eras, and nuances of each issue and tool change described by the year-to-year comparisons, allow the thesis to answer its primary question: How do state water laws in Colorado change over time with respect to the laws' addressed issues and policy tools.

Furthermore, the study utilizes theoretical direction from the Advocacy Coalition Framework and the punctuated-equilibrium theory as well as policy tool selection literature. The changes in policy issues and tools of the law, viewed through learning's of policy change theory, will provide insight to the discussion of how Colorado's water policies changed over time and contribute specific language to describe the analyzed system. Also, incorporating a qualitative review of Colorado's water history, the quantitative analysis of water policy

issues and policy tools at the state legislature, and theoretical understanding of collective decision making processes, a discussion of the next important step can begin: Why have Colorado's water policies changed over time. This thesis does not attempt to answer this question, but only to setup future research to do so by a thorough analysis of how Colorado state policy has changed.

An analysis of state level water policy issues and tools over more than three-quarters of a century has not been done. Dr. Schlager and Dr. Heikkila's data set includes other states in the west and southwest United States with similar time spans. Future researchers can utilize the process developed in this thesis to analyze and describe water policies over time, and build an understanding of how water policy developed over many regions and within entire water basins in terms of policy issues addressed and policy tools used. As good descriptions of how water policy has changed over time are completed, explaining why policy changed can then be tasked.

Before outlining the propositions of the thesis, each theory will be briefly described with a focus on the elements of the theory used in developing the propositions. Next Colorado's water policy history will be reviewed, followed by data analysis and conclusions, and finally a discussion of the results and possibilities of future research.

## **2. Policy Change Theory, Policy Tool Selection, and Research Questions**

The Advocacy Coalition Framework (ACF) and punctuated-equilibrium theory have been used to help explain policy changes and the dynamics of policy subsystems over long periods of time (Weible et al 2010, 523, Baumgartner and Jones 2009, 4). While this piece is neither an ACF or punctuated-equilibrium theory application, nor is it aimed at explaining *why* state level water policies changed in Colorado, the theories will lend to better describe *how* Colorado's water policies changed between 1931 and 2006 and provide useful terminology to discuss policy change. Additionally, the policy tools employed by the Colorado state legislature will be described. Governance scholars suggest an examination of tools can provide insight into the shifting ideologies of the role of government and societal norms (Salamon 2002, 11 and Schneider and Ingram 1990, 523). This thesis will not attempt to classify shifts in ideologies or norms but only to investigate the presence of patterns in policy tool selection.

### **2.1 Advocacy Coalition Framework**

To describe policy change over long periods of time (a decade or more), the Advocacy Coalition Framework employs subsystem-level analysis of subsystem members' beliefs, interactions with other members, and reactions to internal and external pressures (Sabatier and Weible 2007, 192-194 and 196-198). The ACF draws upon individual behavior models and the bounded rational actor (Weible and Sabatier 2009, 196) and applies the behaviors to larger decision-making groups. The key behaviors are that 1) individuals use beliefs to help filter information and 2) because of the complexity of our society, individuals specialize (Sabatier and Weible 2007, 192-194). Through specialization, subsystems are created which are limited to a geographic and substantive topic. The ACF defines a subsystem as the "substantive and geographic scope of the institutions that structure interaction" (Sabatier and Weible 2007, 193) or more simply "the interaction of actors from different institutions interested in a policy area" (Sabatier 1988, 131). Within the subsystem,

individuals who share beliefs form coalitions. In the ACF, coalition beliefs shape policy problem definitions and appropriate solutions and a degree of belief change is a precursor to policy change (Sabatier and Weible 2007, 198).

The ACF's hierarchy for beliefs ranges from least to most likely to change over time: deep core beliefs, which are "predominately normative" (Weible and Sabatier 2007, 196), policy core beliefs (normative and empirical), and secondary beliefs which "include policy proposals and causal perception about only a portion of the subsystem" (Weible and Sabatier 2007, 197). An example of these belief types of the dominant coalition in Colorado's water policy subsystem in the early 1900s, gleaned from secondary literature, could have been:

1. An alignment with *Manifest Destiny* (deep core belief);
2. *Water should be used for human development* (normative policy core belief out of the deep core belief);
3. *Water scarcity is a major problem and water projects such as dams, reservoirs, and diversions are the best solution to provide for farms, homes, and industry* (empirical policy core belief);
4. *The size and location of the water project and the allocation of water supplied by the project* (secondary belief).

Typically a subsystem has two to five coalitions (Sabatier and Weible, 1998, 196), each pursuing policies that align with their beliefs. If more than one coalition is present in a subsystem, and a minority coalition is actively pursuing policy change, ACF scholars postulate policy-change takes place under four circumstances (Nohrstedt n.d., 4):

1. Events occur outside the subsystem's control
2. Shocks occur that are "strongly affected by the actions of subsystem participants" (Nohrstedt n.d., 4).
3. Policy-oriented learning of the dominant coalition
4. Negotiated agreements between the coalitions

A thorough analysis of the water policy subsystem in Colorado was not completed to be able to justifiably define the political and topical limits or the coalition's belief system. However, the terms of *subsystem* and *belief* will be used within the context of ACF's interpretation to aide discussion. 'Subsystem' will be used to describe the institutions and individuals who vie for political concessions, create policy, and administer the tools of Colorado's water. Conceptually, the subsystem includes but is not limited to, members of interstate compacts, Colorado water courts, the state legislature, water administrators, agriculture, industry, and municipal users. The 3. **Colorado Water Policy** Background section describes the role of each of these groups and interests. 'Beliefs' and discussion of belief change will be used to describe possible influences of the observed changes in policy issues and tools in the laws passed by the Colorado state legislature.

## **2.2 Punctuated Equilibrium Theory**

Punctuated-equilibrium theory, like the ACF, utilizes bounded rationality of individuals and applies it to larger collective decision making processes. Bounded rationality "stresses that decision makers are subject to cognitive limits in making choices" and they prefer the current definition of problems and solutions (True et al 2007, 156). Punctuated-equilibrium describes the policy process and its outputs as a normally stable process but one that is also prone to sporadic, large deviations from tradition. By linking the individual's rational and limited attention span to governments, "we have a theory of decision making that is consistent with punctuated-equilibrium theory" (True et al 2007, 156). The bounded rational actor's attributes contribute to institutional friction, and only after sufficient pressure has built (through endogenous and exogenous factors) does significant shifts from the norm occur in policy outputs (True et al 2007, 156, 159-160). In other words, the government's limited focus can shift to new issues when the appropriate motivation is present. To summarize these two points, Punctuated-equilibrium describes the incremental and large policy change observed in government as a combination of:

- The decision makers' cognitive ability and status-quo preferences which limit the number of issues which they focus on at one time.
- If sufficient pressure is present, the decision makers' focus can shift and as a result there are large deviations in policy outcomes.

Punctuated-equilibrium theory also describes subsystems and political influence in policy choice and change. "No political system features continuous discussion on all issues that confront it" (True et al 2007, 158). To overcome the issue-focus-limit and enable parallel processing, larger governments formed multiple committees and each address an issue. Furthermore, interested parties to similar issues form and seek to influence governmental knowledge and decisions; these groups are known as subsystems. The politics within a subsystem can also limit the issues addressed and contribute to institutional friction. Punctuated-equilibrium theory scholars have used the term 'policy monopolies' to describe a policy problem that has a relatively fixed definition and solution set, which is reinforced by advocates, laws, and connected to the decision making groups' ideology (Baumgartner and Jones 2009, 7).

The Advocacy Coalition Framework and the punctuated-equilibrium theory provide the terminology to discuss Colorado's water policies, the peoples and institutions involved. The ACF and punctuated-equilibrium theory also justify a focus on policy issues to describe policy change. ACF and punctuated-equilibrium theory do not specifically limit discussion to policy issues, but they are generally focused on problem and issue definition and the debates in the framing, agenda setting part of the policy process. For example, in Sabatier and Weible (2007, 196) describe actions leading up to policy outcomes:

"The ACF assumes that policy participants strive to translate components of their belief systems into actual policy before their opponents do the same. In order to have any prospect of success, they must seek allies, share resources, and develop complementary strategies."

Punctuated-equilibrium theory “emphasizes two related elements of the policy process: issue definition and agenda setting” (True et al, 2002, 156). The following section moves to policy change at the selection and implementation processes by focusing on policy tool change.

### **2.3 Policy Tool Selection**

Policy change may not be only measured by budgets and adoption of laws but by shifts or innovations in policy tools used to approach issues (Schneider and Ingram 1990, 525). The progression of policy tools over time may uncover patterns that illuminate shifts in the policy makers’ understanding of how to motivate people and of the appropriate role of the government (Schneider and Ingram 1990, 523). Therefore, the selection of policy tools and the primary policy tool used in the Colorado state legislation is necessary and appropriate to study in addition to the laws’ issues to describe policy changes over time in Colorado’s water subsystem. Schneider and Ingram continue by suggesting that “policy instruments often are substitutable, and different regimes will select different instruments even when addressing the same problem” (Schneider and Ingram 1990, 523). Tool choice fits into the discussion of policy change with the ACF and punctuated-equilibrium theory of change because the choices of tool are shaped by similar pressures: ideological predispositions, cultural norms, and interest groups (Salamon 2002, 11).

Lester Salamon in *The Tools of Government* defines a policy tool as “an identifiable method through which collective action is structured to address a public problem” (Salamon 2002, 8). Tools are the techniques used by the government to “achieve policy goals” and initiate “a chain of effects that have important political consequences” (Schneider and Ingram 1990, 527). However, tools are difficult to classify; e.g. in a summary by Salamon of public service policy the number of tools ranged from 16 to 63 (Salamon 2002, 21-22). Furthermore, the number and scale of tools or instruments which public purposes are



pursued have ‘mushroomed’ in recent decades (Salomon 2002, 9). “Whereas earlier government activity was largely restricted to the direct delivery of goods or services by government bureaucrats, it now embraces a dizzying array of loans, loan guarantees, grants, contracts, social regulation, economic regulation, insurance, tax expenditure, vouchers, and more” (Salomon 2002, 2). Generally, many of these new tools reflect a change in the government’s role from one of doing to one of arranging and have set up partnerships with third-party actors to carry out what was a basic government function: “the exercise of discretion over the use of public author and the spending of public funds” (Salomon 2002, 2 and 8).

In summary, policy tools are influenced by political actors’ beliefs, social norms, and interest groups. Over time the same issues have been addressed by different policy tools and these shifts in tools may reflect changes in the ideologies of the current regime. Finally, policy tools have increased in number and variety and have employed third parties to carry out what used to be government functions.

## **2.4 Propositions**

The principles of policy change based on the Advocacy Coalition Framework, punctuated-equilibrium theory, and policy tool selection through governance theories set up a number of propositions to investigate by examining a data set of water related laws passed by the Colorado legislature between 1931 and 2006.

The Advocacy Coalition Framework and punctuated-equilibrium theory both discuss shifts in issue focus within a subsystem based on internal and external forces. This thesis does not attempt to describe the reason for change in focus but only recognize a shift has occurred and therefore the first hypothesis is:

1. The issues that the legislature’s focus on relating to water issues will shift over time.

Punctuated-equilibrium theory describes a limit a group's ability to process information and to increase its ability to parallel process it can create multiple committees. These two insights form propositions two and three:

2. The legislature is limited in the number of issues it can address at one time.
3. The legislative capacity to focus on a limited number of issues increases over time.

Tool selection described by Schneider and Ingram (1990) and Salamon (2002) suggests different regimes may prefer certain policy tools when addressing various issues; that overtime the number of policy tools utilized by the government has increased; and a single issue can be addressed by different policy tools over time. These three insights are the basis of propositions four, five and six:

4. Policy tools used by the legislature shift over time.
5. Tools used by the legislature will be more varied in current periods than in to past periods.
6. A particular issue can be addressed by different tools over time.

### **3. Colorado Water Policy Background**

#### **3.1 Colorado Water Policy: Issues, Values, and Prior Appropriation**

Water oriented legislation has been present in Colorado since the state's inception (Grigg 2003, 13). Not only is water an essential requirement for life and economic development of communities, agriculture, and industry (Gardner 1986, 155 and Bates et al 1993, 29), but it is a particular interest to Colorado, and the rest of the southwestern states, because it is a scarce resource, subject to periods of abundance and periods of need, and its sources do not geographically coincide with the majority of its users (Blomquist et al 2004, 9). In other words, the limited natural water supplies in Colorado are rarely in the right place, at the right time for its demands. Furthermore, Colorado is a headwater state and its water sources connect to other sovereign entities (Pontius 1997, 19-21). For example, the Colorado River basin lies under the boundaries of Colorado and 6 additional states, 2 nations, and 34 Indian Reservations (Pontius, 1997, 2). In addition to the Colorado basin, Colorado is the source of the Arkansas, Platte, and Rio Grande river systems, all of which provide water to neighboring states (Colorado State Engineer 2010, 1). These natural requirements and limitations have set the political stage for competition and conflict among users at the individual, state, and national levels.

In addition to natural factors, political interests, water rights laws, and societal values also influenced Colorado's water policies. The most prominent of these factors discussed in literature are: The prior appropriation doctrine (Blomquist et al 2004, 94 and Bates et al, 1993, 128); politically powerful interests of agriculture, municipalities, and industry (Ingram, 1990, 7); state values of local control and federalism (Hundley, 1986, 15-16, Getches and Meyers 1986, 53); and shared national values of manifest destiny and economic growth (Bates et al 1993, 4, 43, 128). Values toward and influences over water have changed throughout Colorado's history. The conditions that influence policy makers

today are significantly different from those in the past (Weatherford and Brown, 1986, 3). Population growth makes water scarcity a perpetual issue, even with the water projects (dams, reservoirs, and transmountain diversions) in the first three quarters of the 20<sup>th</sup> century. Beginning in the 1960s, environmental needs, Native American rights, and the increased interests in recreational uses of water began to gain traction in the political arena (Bates et al 1993, 46 and 169). These new interests have been added to the discussion as policy makers in the southwestern states respond to the persistent problem of delivering water to the right place and the right time (Blomquist et al 2004, 9, Bates et al 1993, 152-177, Hobbs 2004, 7, Pontius 1997).

The outcome of changing values is apparent in the form that water management took. From the late 1800s to mid-1960s the interests of agribusiness, municipalities, and industry competed for allocation, but they shared identical goals of capturing water for 'beneficial use' (Gardner 1986, 161 and Getches and Meyers 1986, 52-55). These goals aligned with the federal view of big water projects (Udall, introduction, v) and the view that the "highest value of water was for human use [not environmental uses]" (Bates 1993, 44). Because of this, agribusiness', municipalities', and industries' combined political power carried water from its natural sources, through mountains, over natural drainages, and to populations, farms, and business centers hundreds of miles away (Blomquist et al 2004, 91), with little to no resistance, and little to no regard for environmental impacts or water rights to groups outside of their 'iron triangle' (Ingram 1990, 7-10). As of 2010, Colorado had over 2,000 dams and reservoirs constructed within the state (Colorado State Engineer 2010, 1) and, as of 2004, there were "more than 40 transmountain projects, using 16 tunnels and numerous ditches" (Blomquist et al 2004, 93). In the late 1960s, signaled by the National Environmental Policy Act (NEPA) in 1969 and Clean Water Act in 1974, environmental values gained political strength and altered the way water projects were carried out (Udall introduction, vi, Bates et al 1993, 46). Even though agriculture is still the number one user

of water (Bates et al, 1993, 81) and municipalities are growing and competing for more water sources (Kneese and Bonem 1986, 88), their political power has weakened and new interests are engaged in policy decisions (Ingram 1990, 14, Bates et al 1993, 90). By 1985 the “end of the water project development era was fixed” (Ingram 1990, 14). Water management has since moved from storage solutions to efficient use of available resources (Blomquist 2004, 11). At the federal level this change can be seen at the Bureau of Reclamation, who in the late 1980s, shifted its role from construction of new projects to operation and management of existing ones (Udall introduction 1990, vii). Regardless to the change in users, values, and strategies to approach water supply issues, the underlying framework in Colorado to allocate water and settle disputes among users has not changed: the prior appropriation doctrine is still the central method of allocation in Colorado (Blomquist et al 2004, 94).

Early water related disputes in Colorado (namely among the farmers and miners), were addressed by assigning property rights in water through riparian and prior appropriation rights. In 1876, prior appropriation doctrine was incorporated into the Colorado’s constitution as the sole mechanism for ensuring equitable water use and ownership (Hobbs 1997, 6). “Western prior appropriation water law is a property rights-based allocation and administration system, which promotes multiple use of a finite resource” (Hobbs 1997, 2). Prior appropriation gives individuals the right to use a volume of water in the order that the water was put it to ‘beneficial use’ (Bates et al 1993, 136). New water rights can be given, but they are considered junior rights, meaning they only receive their volume after those with senior rights receive theirs (Gardner 1986, 156). Prior appropriation protects senior water holders from junior water holders depleting their supply (Hobbs 1997, 6 and Blomquist 2004, 95). It also protects users who are not adjacent to the water source from losing access to the water (Corbridge and Rice 1999, 32). Prior appropriation doctrine gives the state the right to re-allocate the water if the appropriator is

not using their full volume (Corbridge and Rice 1999, 32 and Blomquist et al 2004, 95 citing Vranesh 1987, 141). Because of the 'use it or lose it' policy, a user who desires to keep their full allocation of water does what they can to use it, regardless of actual need, which has led to wasted water (Gardner 1986, 159). Overtime, prior appropriation has been modified to address new disputes, such as groundwater, but is still the method Colorado uses to manage its water rights (Blomquist 2004, 111).

### **3.2 Colorado's Basic Water Administration Structure**

Colorado's administration of the prior appropriation doctrine and the state's priority of local control have contributed to the complicated web of institutions that govern water rights (Blomquist et al 2004, page 19, 94). The Venn diagram in APPENDIX E depicts basic relationships between the major agencies and the state legislature

- The state legislature sets up the framework and authority for various agencies to control and uphold the state's obligations set by the interstate compacts, federal enactments, and outcomes of the various court systems. Over time, the legislature created, and gave a number of agencies authority to maintain control at the local level and carry out its legislation. Two such agencies are The Division of Water Resources [home of the State Engineer], and the Colorado Water Conservation Board (CWCB) which are the chief water administrators and policy developers for Colorado (Colorado State Engineer, 2010, 3).
- At the Colorado Division of Water Resources and under the State Engineer, local control of water administration is divided into seven divisions (one for each natural water basin) which are then divided into 80 water districts. The seven divisions were created through state legislation in 1969 (Corbridge and Rice 1999, 139). Division level water courts assess individuals' water rights and adjudicate water rights. The Colorado Supreme Court addresses disputes that were not satisfied by

the water court system. Each division court has a water referee and water clerk. The water referee addresses applications for new water rights for all appropriates within their division (Corbridge and Rice 1999, 206). Once rights are defined by the court, division engineers and water commissioners take over the administration (Blomquist et al 2004, 94-97).

- Division engineers and water commissioners serve the districts, advise the courts, and work with water users to ensure water rights are protected (Blomquist 2004, 96-97). The water commissioner assists the division engineer in carrying out their duties and maintains the field offices of the division engineer, and is the “public contact on water administration issues” (Corbridge and Rice 1999, 206). The state legislature can alter the authority of these offices. For example in 1969, legislation was passed which altered the state engineer from more of a passive role to carry out court decisions to an active one, which could look under users headgates, determine compliance, and “exercise judgment” (Corbridge and Rice 1999, 172 and 169).
- The Colorado Water Conservation Board (CWCB) was created by state legislation in 1937 as a sister agency to the State Engineer’s Office (Grigg 2003, 18) and is under the Department of Natural Resources (Colorado State Engineer 2010, 4). Its duties are to  
“promote the conservation of waters in Colorado in order to secure the greatest utilization and prevention of floods; to promote irrigation projects and conservancy districts; to assist such agencies in getting financing; to gather data; to cooperate with the United States in making surveys; to prepare legislative drafts; and to protect the rights of Colorado in interstate matters” (Grigg 2003, 19 quoting Daniel Tyler’s “Last Water Hole in the West: the Colorado Big Thompson Project and the Northern Colorado Water Conservancy District” 1992).

While the State Engineer’s office is meant to be a neutral law enforcement agency and apply calculated judgments, the CWCB can “consider broad equity and

geographic issues in the state's effort to plan its water resources" (Grigg 2003, 19). And so between the two agencies, water administration is carried out and strategic efforts and policies can be developed. The legislature steps in when additional funding or initiatives are needed to assist these state agencies. The state legislature also continues to appropriate funds and staff to the CWCB (State Engineer 2010, 4).

These are the basic governmental groups used in Colorado to manage surface water. Some designations of groundwater and transmountain water sources required the state legislature to create other administrative groups. These include water conservancy districts and the Colorado Ground Water Commission. Above all of these interactions, Colorado must adhere to, and react to federal and inter-state decisions and actions.

### **3.3 Colorado Water Policy Changes Over Time**

Colorado's water policies changed with the shifts in values and the rise of varied interest groups (Grigg 2003 1-18). Justice Hobbs describes Colorado's water law as "one of adaption and change" (Hobbs 2004, 4). The largest difference in policy outputs between 'then' and 'now' is that "twenty years ago...results were counted in terms of new projects...[and]...today success in water politics is measured in paper" (Ingram 1990, 23), meaning that the era of big water projects is over and it is now the methods and tools of water management that are the focus of today's policy makers (Reisner and Bates 1990, 48 and Blomquist et al 2004, 4).

Large shifts in water policy revealed by many scholars refer to the big water project and environmental eras (Ingram 1990, 14, Bates et al, 1993, 160-162). Grouping history into eras allows for a more structured analysis over large periods of time of complicated systems based on the most distinguishing features over time. However as Schlager and Blomquist (2008, 29) point out in the examination of watershed management, as a new era begins it "does not represent a sweeping away of previous management approaches as much as a



grafting of new strategies and policies to new one.” The application of eras to describe shifts in focus of water management and policy is not new. For example, Sabatier, Weible, and Ficker (2005) described five periods in water management in the United States (Sabatier et al 2005, 24):

1. The Manifest Destiny Era (pre-1890s)
2. The Progressive Era (1890-1924)
3. The Federal/New Deal Era (1925-1964)
4. The Environmental Era (1965-1986)
5. The Collaborative Era (1987-present)

Schlager and Blomquist (2008) focused on three eras of watershed management in the United States (Schlager and Blomquist 2008, 29-48):

1. River Basin Development (1933-1965)
2. River Basin Commissions (1965-1980)
3. The Watershed Movement (1980s to 2007)

Grigg (2003) described the following eras in Colorado water development (Grigg 2003, 97):

1. Early Settlement, Initial water (1830-1900)
2. Water development era (1900-1950)
3. Law tune-up era (1950-1975)
4. Environment, regulation, litigation era (1975-2000)
5. Growth, efficiency, environment era? (2000-2050)

Frank et al (2011), focused solely on Colorado and the issues the state was addressing, described the state to have the following five eras:

1. Establishment of the Prior Appropriate Doctrine: 1850-1900s
2. Shifting Focus (1900-1950s)
3. Redefining Boundaries (1950s-1965)
4. Growing Conflicts (1965-1980s)
5. Cooperation Among Conflict (1980s-2006)

The next section will describe the major Federal and Colorado policies and court decisions under the hierarchy of eras offered by Frank et al 2011 which drew upon Grigg (2003, 97) Sabatier et al 2005,24). Eras are useful because they allow for a thematic description of a period and bring over-arching ideas to the surface. The chronology of historic laws and court decisions described below, with each era, was adapted from Justice Hobbs' timeline in the 2004 revised edition of "Citizen's Guide to Colorado Water Law". APPENDIX A offers a direct comparison of each author's era timeline<sup>1</sup>.

### **3.3.1 Establishment Of The Prior Appropriate Doctrine (1850-1900s)**

Early in Colorado's history, federal legislation set up property rights for land and water and through the 1866 Mining Act which 'allowed settlers to...divert water on public land' (Hobbs 2004, 5). This and other federal laws set up the framework for Colorado to govern water use (Hobbs 2004, 5). As homesteaders came to Colorado in the 1860s cooperatives and colonies were set up and diverted ever-increasing amounts of water away from streams and set up the basics of Colorado's water law; prior appropriation and riparian rights. Conflicts among farmers and droughts in the early 1870s pushed irrigators to meet and begin discussion to solely use prior appropriation laws (Grigg 2003, 13-14). By the time of the Colorado Constitution in 1876, the prior appropriation doctrine was the accepted form of allocating rights to those who wish to divert and use water (Grigg 2003, 14).

### **3.3.2 Shifting Focus (1900-1950s)**

At the federal level, congress passed the Reclamation Act in 1902 to provide financing for the "construction and operation of water diversion, storage, and delivery projects to assist irrigation in the western states" (Hobbs 2004, 28). This act was modified quickly to include any 'beneficial use' by the Colorado Assembly (Hobbs 2004, 29). Water

---

<sup>1</sup> Note that the dates of Frank et al 2011 eras have hard end dates based on this work to allow for breaks in the timeline. A brief description of Frank et al 2011 work and how they exact beginning and end dates of each era were determined is found in the Methods section.

supply in the early 1900s was considered Denver's "most serious problem" (Hundley 1986, 14). Concern for water supply was not confined to Colorado. California was also looking for water sources to feed its growing economy and began to utilize the federal funds for its water projects but Colorado and other western states "wanted water projects of their own" (Hundley 1986, 14). Competition for federal funds and allocation of interstate water sources began and led to the first interstate compact. Three forces in the early 1900s led to the first interstate compacts. 1) The projects recommended by the federal government and accepted by California to capture and divert water on the Colorado River; 2) the U.S. Supreme Court decision in *Wyoming v. Colorado* announced "the rule of priority applied regardless of state lines" (Hundley 1986, 14) which legally started the race between states for water-use projects; and 3) Fear losing state control of interstate rivers (Hundley 1984,16). By the end of 1922, the Colorado River Compact and the La Plata River Compact were signed (Hundley 1986, 14-17 and Hobbs 2004, 29). The compacts essentially replaced prior appropriation rules between states with an agreed upon equitable apportionment, set by minimum delivery volumes or percent of river flows<sup>2</sup> (Corbridge and Rice 1999, 541). The compacts allowed slower-to-develop states to generate projects at their own pace and not worry about the rate at which other states, which were connected by a mutual river system, put the resource to beneficial use (Hundley 1986, 15). At this time Native American Rights and Mexico's water rights were left largely out of water related legislation (Hundley 1986, 18).

The second half of Frank et al (2011) "Shifting Focus" era is described as the "Federal/New Deal Era" by Sabatier et al (2005,31). Actions during this period "represented a continuation and refinement of approaches developed during the Progressive Era[1900-

---

<sup>2</sup> The Colorado Compact for example promised the lower basin states 7.5 million acre feet each year or 75 million acre-feet every ten years through a point known as Lee Ferry; later an Upper Colorado Basin Act awarded the states a percent of flow instead of a volume (Corbridge and Rice 1999, 542-544 and Getches and Meyers (1986, 53-54)

1924]" (Sabatier et al 2005, 31). Major policies like interstate compacts, and federally financed projects that put water to work in municipalities, farms, and hydroelectric plants dominated water decisions through the 1950s (Hobbs 2004, 29, Hundley 1986 14-29). However, nuanced policy changes were occurring. In 1951 the Colorado Supreme Court case, *Salfranek v. Town of Limon*, decided ground water is "presumed to be tributary to a surface stream and is subject to the prior appropriation system" unless proven otherwise (Hobbs 2004, 29). This decision reflects the conflicts among interstate water users and an understanding of hydrology. Other reflections of a shifting focus were seen in 1956 when Congress rejected a portion of Colorado's 1952 River Storage Project Bill and saved Echo Park, a wilderness area, from becoming a source of hydroelectric power. With this decision, pro-environment advocates had a major victory. Congress stated "no dam or reservoir constructed under the authorization of the [Colorado River Storage] Act shall be within any National Park or Monument" (Hundley 1986, 29). In 1964 the U.S. Supreme Court in *Arizona v. California* determined federal water reserves (including Native American Reservations) had priority under the prior appropriation doctrine (Hobbs 2004, 29). These two decisions indicated a broadening of issues at the federal level which state legislatures must also consider.

### **3.3.3 Redefining Boundaries (1950-1965) and Growing Conflicts (1965-1980s)**

Also described by Sabatier et al (2005) as the "Environmental Era", we see a shift in state and national policy that recognizes new values and introduces steps in the project approval process that focus on environmental stewardship. 1969 in particular, brought large changes to Colorado water policy. Congress passed the National Environmental Policy Act (NEPA) which "set the stage for the current era [referring to the late 1980s] of water politics" (Udall, introduction, vi). NEPA had a great effect on federally financed water projects by increasing the transaction cost to the states through the development of detailed planning procedures (Corbirdge and Rice 1999, 410). At the state level,

groundwater conflicts had continued since the 1951 decision and in 1968, “an engineering study was authorized by the Colorado legislature to provide recommendation of integrating use of alluvial (tributary) groundwater into the surface water system”(Cech 2010, 310). Following the study, the 1969 Water Rights Determination and Administration Act more explicitly addresses the ground and surface water connection by incorporating groundwater into the into the surface water prior appropriation system (Corbridge and Rice 1999, 143). In addition to addressing ground and surface water conflicts, the 1969 Act divided the state into 7 divisions, altering water institutions in the state through the modification their powers and authority. Adjudication of water rights transferred from the 80 district courts to the 7 new division water courts (Corbridge and Rice 1999, 142), and removed the independent power of local water commissioners and placed this position under the state engineer (whose duties were carried out by division engineers) (Corbridge and Rice 1999, 206). The state engineer’s power was increased to be able to actively manage water resources instead of reacting to court decisions (Corbridge and Rice 1999, 172). The 1969 Act also explicitly added environmental concerns to the definition of ‘beneficial use’ (Corbridge and Rice 1999,45).

Environmental issues at the state and federal levels continued through the end of the era. In 1973 the Colorado General Assembly adopted the instream flow and lake level law. The law allowed the Colorado Water Conservation Board (CWCB) to acquire “water rights sufficient to preserve the natural environment to a reasonable degree” (Hobbs 2004, 30). Other major federal policies that impacted water projects and water management were the Endangered Species Act was passed in 1973, and the Clean Water Act was passed in 1977(Sabatier et al 2005, 42).

### 3.3.4 Cooperation among Conflict (1980s-2006)

Hobbs' chronology during this time period highlights court decisions more often than legislative ones. The issues addressed in the previous era (groundwater and the environment) continued to be the subject of court and legislative decisions (Hobbs 2004, 30). In 1983, the Colorado Supreme Court decided the prior appropriation doctrine does not apply to non-tributary ground water. Through the 1980s and 1990s Colorado Supreme Court decisions continued or enhanced the use and rights of instream flow tools<sup>3</sup> for the enhancement of the environment, recreation, and fishing flows. In 2002, the General Assembly passed a law allowing the CWCB to not only to provide "minimum stream flows or lake levels to preserve the natural environment" but to improve stream conditions (Hobbs 2004, 30).

Two new methods to address water allocation and water storage were implemented during this era: water banks and transferring agricultural water out of counties (to municipalities). In 1996, standards were established for transferring large amounts of agricultural rights to municipalities and in 2003, the General Assembly adopted legislation requiring "financial mitigation to a county when transferring agricultural water permanently out of the county, and authorize(d) interruptible water leasing from farms to cities and for instream flows during drought emergencies" (Hobbs 2004, 30). Water Banks started with a pilot tool in the Arkansas River Basin and, in 2003, legislation was adopted for "stored water banks<sup>4</sup> in all seven Water Divisions" (Hobbs 2004, 30).

---

<sup>3</sup> Instream flow tools allow the Colorado Water Conservation Board the right to set minimum stream flows and, adopted later, authorized the CWCB to purchase water rights to maintain instream flows (Corbridge and Rice 1999, 40-41)

<sup>4</sup> Water banks tools were created to "simplify and improve the approval of water leases, loans, and exchanges...to reduce the [transaction] costs, and increase the availability of water-related information" (Arkansas River Pilot Water Banking Act, (2001). HB 01-1354 §37-80.5-101.)

These policy changes over time show the persistent nature of certain water issues in Colorado, namely, how to protect water rights and allocating water to where it is needed. It also demonstrates how legislature's agendas change with emerging issues like protecting watersheds and the species and habitats the watersheds support. Additionally, the way old issues were addressed by policy makers expanded over time. The tools of water storage and flow control that protected citizens from drought and flood in the first half of the century were no longer viable in the latter part. With the expanding population, new tools were needed to more efficiently use the water resources available and protect the required flows of nature. Examples of the new tools include: augmentation plans, alternate points of diversion, and water banks.

The changes in approach to Colorado's water issues can be highlighted by two important pieces of legislation in Colorado. The interstate Compact of 1922 which joined 7 states and the federal government in finding an equitable solution to water rights on the Colorado River, and the 1969 Water Right Determination and Administration Act which sought to address administrative problems and conflicts among Colorado water users. They draw attention to the interactions between different levels of government, the salient issues of their time, and the tools used by policy makers to address the issues.

### **3.4 Colorado River Compact of 1922**

The 1922 Colorado River Compact has roots in California's "All-American" canal and their lobbying to bring water from the Colorado River to irrigate the Imperial Valley. In essence, the canal would allow farmers access to water without being reliant on Mexico (Corbridge and Rice 1999, 540). California farmers were concerned their crops' water would be absorbed "like a great sponge" by Mexico's potential growth (Hundley 1986, 12). Due to the cost of the project, Imperial Valley farmers went to Washington, D.C. for help (Hundley 1986, 12).

Arthur Powell Davis, a proponent of large water projects on the Colorado River, caught wind of the canal project and moved to connect it to his own development plans (Hundley 1986, 12). By reminding the advocates of the “All-American” canal of damaging floods in 1905 and 1906 he soon had support from locals and congress to build storage sites in the lower-basin of the Colorado River (Hundley 1986, 12-13). The lower river basin of the Colorado River includes California, most of Arizona, New Mexico, and Nevada and the upper basin states are Colorado, Wyoming, and Utah. At the time the Lower Basin was expanding at a greater rate than the Upper Basin (Corbridge and Rice 1999, 541). After the U.S. Supreme court declared prior appropriation rules “applied regardless of state lines” (Hundley 1986, 15), the Upper Basin feared they would lose their share of the water flowing through their states and lose an adequate supply of water for future development (Corbridge and Rice 1999, 141 and Getches and Meyers 1986, 55). The Lower Basin, on the other hand, wanted to meet the needs of their expanding population centers and agricultural economy (Getches Meyers 1986, 55). To address the allocation issue between states, Colorado attorney Delph Carpenter lobbied the other Colorado basin states to enter into a compact so that the states could “put their house in order.” Carpenter feared that otherwise the federal government would take control of the issue themselves and weaken “state autonomy on all rivers” (Hundley 1986, 16). The states agreed, and the federal government sent Herbert Hoover as their representative (Hundley 1986, 16).

When all deliberations were said and done 7 years later the Colorado River was divided into the upper and lower basins at a point known as Lees Ferry (Corbridge and Rice 1999, 541) and the lower basin states had individual allocations (Hundley 1986, 22). The upper Basin was to deliver 7.5 million acre feet per year or (in case of yearly fluctuations in flow) a decennial amount of “75,000,000 acre feet for any period of ten consecutive years” (Corbridge and Rice 1999, 542). Yearly rights were limited to the basins; the Upper basin could not “gain rights in excess of 7.5 million acre feet and the Lower Basin [could not]



acquire rights in excess of 8.5 million acre feet” (Corbridge and Rice 1999, 542). The compact also incorporated articles for contingencies concerning any future federal treaty with Mexico stating that, “such waters shall be supplied from the waters which are surplus over and above the aggregate of the quantities specified...if the surplus proved to insufficient, then the deficiency would be borne equally by the upper and lower basin [states]” (Corbridge and Rice 1999 542). Native American rights were “perfunctorily” dealt with in an article which stated “Nothing in this compact shall be construed as affecting the obligations of the United States of America to Indian tribes” (Hundley 1986, 18). Both Mexican and Native American “rights were considered negligible” (Hundley 1986, 18). Hundley offers an observation of Herbert Hoover (referring to Mexico) “We do not believe they ever had any rights”. Furthermore, “agricultural and domestic purposes” were given the highest priority (Hundley 1986, 18).

In parallel with the compact was the Boulder Canyon Act. This Act was used as a negotiation piece between the basins and the states. After the formal signing of the compact in November 1922, all the states except Arizona ratified the compact. Arizona feared the upper and lower basin allocations, in the current version of the compact, would leave the upper basin protected and put them in competition (and be defeated) with California (Hundley 1986, 19). Additionally, Arizona learned upper basin states would support the Boulder Canyon Act once the compact was signed (Hundley 1986, 19). The Boulder Canyon legislation would mean approval of the compact and provide federal approval and funding for a 20,000,000 acre-foot storage dam and the All-American Canal; both to serve California (Corbridge and Rice 1999, 543). After years of deliberation between the states and federal government, Arizona conceded and the final conditions of the compact and Boulder Canyon Bill were set. Within this bill the lower basin states had precise limits to their use. Congress approved the Boulder Canyon Bill, and with that

“California legislature agreed to the limitations imposed by Congress” and by 1929 the act was effective (Hundley 1986, 21-22).

The proceedings of the 1922 interstate compact illustrates the state to state and federal to state forces, as well as the strong values of equity and state sovereignty at the time. Dr. Hundley’s description of the deliberation and conflicts that arose through the commencement of the Colorado River Commission in January, 1922, its signing in November 1922, and its final ratification by congress in June, 1929 tells of the considerable effort by each state to get as much water allocated and federal funds for projects as possible, and sharing future burdens of international treaties and droughts equally (Hundley 1986, 14-22). It also highlights the values held by the federal government and states toward domestic rights, and toward agricultural and municipal use of water. Finally, early on in the compact negotiations, it was noted by Hundley that the Upper Basin states were under great pressure to reach a settlement, because they “feared if they did not negotiate a water supply for themselves, a disastrous flood on the lower river might stampede Congress into giving Californians the legislation that they wanted.” (Hundley 1986, 16). This example and Carpenters’ invocation of the 1905 and 1906 floods show decisions based on environmental events in water policy are not necessarily reactive. The concern over drought and flood are certainly a constant among the decisions for water policy in the arid region of the southwest.

### **3.5 The 1969 Water Rights and Determination Act**

The 1969 Water Rights and Determination Act changed the way water was managed in Colorado. The most prominent changes were:

- The state’s hierarchy of control (making it slightly less locally controlled),
- The states’ methods of tracking priority,
- The role of the state engineer,

- The definition of 'beneficial use' to include instream flows,
- Ground and surface water use were linked through the same prior appropriation laws and,
- The 1969 Act introduced the concepts to improve efficient use of both ground and surface water; notably plans for augmentation and exchange tools (Corbridge and Rice 1999, 45 and 141-153).

Previous legislation had created a confusing and uncertain method of prioritization through district level control. The hierarchical and tracking changes in 1969 Act were the state legislature's recognition to this problem (Corbridge and Rice 1999, 142). Incorporating tributary groundwater within the bounds of the surface water prior appropriation system, which was moved through legislation with the help of surface water owner lobbying (Cech 2010, 311), helped the state engineer "resolve the conflict between groundwater and surface water users" (Blomquist 2004, 101).

Prior to the Water Rights Determination and Administration Act of 1969, Colorado's water rights were given by district courts, of which there are approximately 80 (Corbridge and Rice 1999, 139). Because the old districts did not follow hydrological boundaries, water priorities between districts within the same watershed were misaligned; therefore the order of water rights were compromised (Corbridge and Rice 1999, 141). The 1969 Act created 7 divisions in Colorado that followed the natural boundaries of Colorado's water basins. It was "the first attempt to provide [a] comprehensive, integrate scheme of adjudication and tabulation of water rights" (Corbridge and Rice 1999, 139). It helped to align priorities and keep the "'first in time, first in right' order" (Corbridge and Rice 1999, 139). A division court was established which bumped up water adjudication from the district level to the division level. Now all water rights within a water system were handled by a single court. Beneath the division judges were water referee's and water clerks. These three positions served the districts. The referees determined water rights and conditional water rights when new

applications entered the system (Corbridge and Rice 1999, 166). The clerks maintained records of the proceedings and actions of the court (Corbridge and Rice 1999, 168). Assisting the administration of water rights were the division engineers, who worked for the state engineers office, housed in the Department of Natural Resources.

The state engineer's role was also altered. Under the Act, the state engineer, through division engineers, could now "actively participate in the management of water resources rather than, as under prior law, passively observing water usage with the power only to administer court decrees" (Corbridge and Rice 1999, 172). Meaning they could now look below the headgate to check actual water usage and "exercise their judgment as to the efficient use of water" and "curtail waste, defined as water not necessary for application to a beneficial use" (Corbridge and Rice 1999, 172 and 169). Furthermore, the Act called for the state engineer to tabulate and publish all water rights within each division (Corbridge and Rice 1999, 174-175). The goal of the tabulation was to have a record of "all existing water rights in each division" and to track priority and abandonment of rights (Corbridge and Rice 1999, 175). The 1969 Act also removed the commissioner's independent power. The commissioner is now appointed by the division engineer (Corbridge and Rice 1999, 206). Other significant changes of the 1969 Act were altering the definition of 'beneficial use' and addressing the groundwater and surface water conflict.

The 1969 Act more clearly defined the term 'beneficial use' to include "minimum flows between specific points or levels for an on natural streams and lakes as are required to preserve the natural environment" (Corbridge and Rice 1999, 44). This language in the 1969 Act which augmented 'beneficial use' opened the door for future legislation to implement the instream flow program administered by the Colorado Water Conservation Board (Hobbs, 1999, 10). The board, among other duties, coordinates interstate water transfers and transmountain water transfers (Corbridge and Rice 1999, 45 and 206-209).

For years, ground water users suspected wells were reducing their stream flows. To answer this concern the state legislature passed the 1965 Ground Water Management Act began regulating and categorizing ground water that was and was not connected to surface water sources (designated and nontributary ground water, respectively) (Hobbs 2004, 10). Then in 1968 the legislature approved an engineering study to “provide recommendations for integrated the use of alluvial (tributary) groundwater into the surface water system (Cech 2010, 310). The 1969 Act incorporated ground water allocation into the prior appropriation system used by surface water users (Corbridge and Rice 1999, 143). It also created augmentation plans which “provided for [a] method of solving well and stream user conflicts” (Blomquist et al 2004, 101). The Act also “provides for substitution of water in an exchange tool” (Corbridge and Rice 1999, 143).

“The 1969 Act clarified the priority system by creating a public ordering of all rights, provided incentives to well owners to adjudicate their tributary groundwater rights, and provided a mechanism by which well owners could avoid being shut down” (Blomquist et al 2004, 101).

The augmentation plans and exchange tools allowed junior right holders to make up their use to senior holders by supplying water from a separate source of diversion, “by pooling water resources, by water exchange projects, by providing substitute supplies of water, by the development of new sources, or by any other appropriate means.” In addition to creating a method for well owners to substitute the water they were depleting from streams, it let those who had stream rights and a tributary groundwater well to alternate between points of diversion. Therefore when a stream’s level was low, they owner could switch diversion to the well to fulfill their allocation (Corbridge and Rice 1999, 154).

In summary, the 1969 Water Right Administration and Determination Act recognized new issues and addressed old issues with new or revised tools.

- New environmental issues were addressed by including the use of water for recreational purposes and augmented 'beneficial use' to include minimum flows of streams and lakes (Corbridge and Rice 1999, 44) which later led the instream flow tool (Hobbs 1999, 10). Prior to this addition, 'beneficial use' had mostly been oriented to human and economic development uses (Corbridge and Rice 1999, 44-45).
- Old water allocation issues were addressed by new tools. First, by dividing the state by division rather than district and creating the tabulation tool improved the efficiency and confusion of the old system; and second, including augmentation and alternate the prior appropriation aided in allocating rights to junior appropriators
- The issue of water rights between ground and well water sources was recognized for the first time. Augmentation and alternate points of diversion were the tools used to address this issue.

#### **4. Methods of Analysis**

Based on the above secondary literature review of Colorado's water policies, it is apparent there were shifts in focus of the law makers; shifts on what issues were important and shifts in how best to address those issues. The following sections will describe the methods used to analyze a data set of Colorado state laws relating to water management, the issues present in the laws, and the policy tools provided in the law to quantitatively answer the question "How do state water laws in Colorado change over time with respect to the laws' addressed issues and policy tools".

##### **4.1 Data Collection**

The laws were collected by Dr. Heikkila and Dr. Schlager from 2005-2007, as part of a larger project funded by the National Science Foundation. The Colorado data set included 306 laws, relating to water, which were passed by the Colorado State Legislature between 1931 and 2006. Laws which constituted "minor revisions of an existing law (minor revisions apply to name changes; spelling corrections; date changes [for instance, the date of elections]; length of time an action must take place within, such as filing a report or an appeal; or any other modest changes that do not affect the substance of the law)" were excluded from the study. 226 of the 306 laws were non-minor laws and was the focus of this study. Each non-minor law was coded for attributes including:

**Table 1. Coded attributes**

1. Purpose of the law
2. Whether or not the law mentioned interstate compacts
3. Each issue addressed in the law
4. Each program/tool<sup>5</sup> used in the law
5. The primary program/tool of the law
6. If the law created enabling legislation, multi-stakeholder groups, power sharing among agencies or citizens, or administrative districts or sub districts of an existing agency
7. The scope of the law (statewide, regional, basin)
8. The sector the law addressed (agriculture/irrigation, municipalities/counties, individual, or all sectors)

Attributes of the law used in this analysis were: the policy issues addressed by the law, all tools established in addressing the issue of concern, and the primary tool established. Each non-minor law was coded for each policy issue addressed in the law. Multiple issues could be coded for each law. The Issues were:

---

<sup>5</sup> The codebook uses the term 'program' and 'tool' interchangeably. From the code book 'program' is defined "the types of tools or policy mechanisms that the law establishes in addressing the issue of concern". This definition is in-line with the definitions of policy tools provided by Ingram and Schneider (1990) and Salamon (2002) stated above in section 2.3 **Policy Tool Selection**. Because of this and the literature's explicit separation between policy 'program' and 'tool', the programs of the code book will be referred to as policy tools.



**Table 2. List of policy issues from the codebook**

1. Water quality
2. Water allocation
3. Water storage
4. Species or habitat protection
5. Watershed restoration or enhancement
6. Authority or powers of agency or district
7. Other<sup>6</sup>

Policy tools were coded twice; the first code describes all tools used in the legislation to address the issues of the law. The second code is the primary code of the law. Table 3 gives the definition of each policy tool available in the code book. These definitions were used for both 'all tools' and the 'primary tool' used in the non-minor law. Table 3 also shows how each tool was categorized for this analysis.

---

<sup>6</sup> The 'Other' issue category is a source of weakness for the data set. 'Other' was coded when the issues in the law did not relate to the other 6 categories. Between 1931 and 1984 'Other' issues made up for 10% (15 of 148 issues) of all issue codes. Between 1985 and 2006, however, 'Other' issues made up 33% (46 of 141 issues) of all issue codes. The use of the 'Other' issue category is expected as there are many more types of issues than the other six explicit categories. However 39 of the 61 times 'Other' was coded, it was the only issue coded for the law; 37 of these were coded after 1985. A review of a few of the laws which 'Other' was the only issue coded appeared to be more appropriately coded to one of the explicit issue categories. It is suggested that future analyses with this data set review the 39 laws.

**Table 3. Tool category and description**

Final Category	Initial Category	Description of the Program
<b>Regulation</b>	Regulation	specific language in the law/rule that requires specific actions or forbids specific action
<b>Permits</b>	Permits	specific language in the law/rule requires actors (citizens, organizations, companies, etc.) to first obtain permission from the state before proceeding with an action or activity. If the state approves of the action, the state issues a permit to the actor.
<b>Property rights</b>	Property rights	specific language in the law/rule that defines property rights in a thing, for instance, the law may state that all waste water belongs to the entity that created it
<b>Enforcement</b>	Enforcement	language discussing or providing for mechanisms for enforcing a rule, policy, law, or program
<b>Monitoring</b>	Monitoring	language discussing or providing for mechanisms for monitoring water rights or water quality
<b>Public Works/Infrastructure</b>	Public Works/Infrastructure	language in the law/rule that provides for the development or maintenance of public works or infrastructure
<b>Information Collection and Planning</b>	Information collection	specific language in the law/rule that requires the state agency to gather and store data or that requires actors to report data to the state.
	Planning	specific language within the law/rule that establishes a process requiring actors to anticipate events or changes in key indicators and to develop alternative means of addressing the changes; for instance, a law may establish a state water planning process that requires local actors to inventory their water supplies, identify likely new sources of supply, anticipate future uses and problems, and develop alternative approaches for addressing future outcomes. In other words, the law/rule requires actors to identify future scenarios and how to address them.
<b>Finance</b>	User Fees	specific language within the law/rule that establishes a program whereby water users must pay for a water-related service, such as delivery or treatment
	Grants and/or loans	specific language within the law/rule that allows for an actor to apply for assistance for a specific project, such as a low interest loan to purchase and install water saving technologies. Grants and/or loans may be very similar to subsidies or cost-sharing because both types of programs involve actors receiving financial support from the state. Use your best judgment to distinguish between the two programs.
	Bonds	language within the law or rule that establishes the authority to provide funding for water related infrastructure or services through bonds
	Taxes	language within the law/rule that establishes authority to provide funding for water related infrastructure or services through taxes
	Subsidies or cost-sharing	specific language within the law/rule that establishes a program whereby the state pays the actor for engaging in an activity, such as fencing a stream to keep cattle away from it
<b>Omitted</b>	Markets	specific language in the law/rule allows actors to lease, purchase, or sell a thing; may also define mechanisms encouraging exchanges
	Education	specific language within the law/rule that established clearly identifiable education programs, such as holding fairs, sponsoring forums, developing curricula, etc.

## 4.2 Dataset Groups and Timeframes

A number of the policy tool categories were collapsed for the purpose of increasing the tools' N values for stronger statistical comparisons and to reduce the total number of analysis needed (depicted in **Error! Reference source not found.**).

- Five tools, 'Grants and/or loans', 'Bond', 'Taxes', 'User Fees', and 'Subsidies or cost-sharing', were combined into a 'Finance' category. Individually, these tools were used between 10 and 23 times in the 226 laws. Combined, the 'Finance' N was equal to 82. There was very little overlap of 'Finance' tools within a single law: 12 laws of 226 had more than one 'Finance' tool coded.
- 'Planning' and 'Information Collection' were combined into a 'Planning and Information Collection'. Individually, 'Information Collection' and 'Planning' tools were present 21 and 49 times, respectively. Seventy one percent (71%) of 'Information Collection' tools were present in the same laws with 'Planning' tools and therefore the combination of the two tools was assumed appropriate.
- 'Markets', 'Elections', and 'Education' tools were used in 10, 15, and 4 laws respectively and therefore they were not individually examined.
- Finally, when analyzing the policy issue and primary tool codes, in section **5.1.5 Relationship Between Policy Issues and Primary Tools**, these groupings were not used.

The data were also grouped by varying time periods. Non-minor laws were grouped by year, decade, and era. The utility of applying eras to the data set evolved through previous analysis completed at the School of Public Affairs at the University of Colorado – Denver from spring 2010 through spring 2011. Dr. Heikkila and Dr. Weible led a group of Masters Students who analyzed Colorado Water history from the early 20<sup>th</sup> century to the present. The data set of this analysis was the basis for the previous work. To enhance and

give the data context, a historical perspective was needed. Frank et al (2011), an unpublished analysis which, through reviews of secondary literature of Colorado's water policy, history, and politics, described themes and set eras, to help explain how water policies shifted throughout the years. The eras were based on policy issues and methods used by active players to address those issues as previously defined eras that were cited in secondary literature, namely Sabatier et al (2005) and Grigg (2002). Eras allowed the research team to purposefully scan the Heikkila-Schlager dataset for similar logical breaks and to highlight the types of issues and tools that were seen most or least often in the legislation during those times. Comparing each era allowed for a clearer understanding of the story of water policy in Colorado. The eras' outlined by Frank et al (2011) were; Establishment of the Prior Appropriate Doctrine: 1850-1900s'; Shifting Focus: 1900s-1950s; Redefining Boundaries, a look at Groundwater in Colorado: 1950s-1965; Growing Conflicts: 1966-1980s; and Cooperation among Conflict: 1980s-2006. For this analysis, the Heikkila-Schlager data set required precise years for each era. Preliminary analysis of the eras set by Frank et al (2011) determined precise beginning and ends for each; Era 1: 1931-1950; Era 2: 1951-1965; Era 3: 1966-1984; Era 4: 1985-2006<sup>7</sup>.

---

<sup>7</sup> The data set begins in 1931, which is approximately mid-way through the second era defined by Frank et al 2011, and so the first era addressed in this analysis begins in 1931. The cut-off date between Era 1 and Era 2, according to Frank et al, 2011, was in the 1950s. An examination of all issues present in the laws finds the 1951 start time for Era 2 was appropriate because it is in this year that the issue of 'Water Allocation' began a 6-year dominance in issues. Combining 'Authority or Powers of an Agency or District' to 'Water Allocation' strengthens the case for 1951 to be the start date of Era 2. The two issues made up for 88% of the issues addressed during the time period from 1951 to 1965. To test the breaks in era 2, when one year was added to either end, the percent of issue dominance by 'Authority or Powers of an Agency or District' and 'Water Allocation' issues drops between two and six percentage points. Therefore, the 2nd era was between 1951 and 1965. The last date needed to define the last two eras is at the end of Era 3 in the 1980s. The drop in the combined issue percent per year of 'Water Allocation' and 'Authority or Power of an Agency or District' in 1984 determined the break for era 3 and era 4.

### 4.3 Calculations

Four types of calculations, in addition to basic descriptive statistics, were used to describe policy issue and tool change over time and the relationship between the two, in the 226 non-minor laws passed by the Colorado State Legislature between 1931 and 2006. A detailed explanation of the calculations is in APPENDIX B. The five types of calculations used and the Proposition the outcomes helped address were:

1. Percent of total issues or tools for each individual issue or tool for selected time periods; used to show relative change in focus for each issue and tool. Excel was used for all percent calculations.

**Proposition 1:** The issues that the legislature's focus on relating to water issues will shift over time.

**Proposition 4:** Policy tools used by the legislature shift over time.

**Proposition 5:** Tools used by the legislature will be more varied in current periods than in to past periods.

2. Relationship between issues and primary policy tool and statistically calculated correlation between issues and all tools. Correlation test between policy issues and all tools used Fischer's exact test for significance and phi value for symmetry. SPSS was used for the cross-tab analysis. The presence of each policy tool and issue was used in the calculation, not the total number. Meaning, if 'Regulation' was used 6 times in 1975 and 1 time in 1978 the code for both years was 1. Fischer's exact test was used and a p-value less than 0.1 was identified as a strong relationship. The Phi value was used to understand if the relationship was positive or negative. A positive relationship indicated both the tool and the issue were present. The positive relationships were used to describe how issue and tools were used together over time.

**Proposition 4:** Policy tools used by the legislature shift over time.

**Proposition 5:** Tools used by the legislature will be more varied in current periods than in to past periods.

**Proposition 6:** A particular issue can be addressed by different tools over time.

3. Individual t-tests; used to compare the number of issues between selected time periods and the difference variability of issues and tools. SPSS was used for the t-test calculations.

**Proposition 2:** The legislature is limited in the number of issues it can address at one time.

**Proposition 3:** The legislative capacity to focus on a limited number of issues increases over time.

4. Pierson's R correlation; used to compare relationship between selected policy issues. Excel was used for all Pierson's R correlation calculations.

**Proposition 2:** The legislature is limited in the number of issues it can address at one time.

The following section describes the result of the descriptive statistics as well as the four more specific calculations at different time scales. Era level analysis of the number of laws, the types of issues, policy tools, and primary policy tools is first, followed a discussion about the relationship between issues and tools and issues and primary tools. Next is a year-to-year analysis of laws, issues, all policy tools, and primary policy tools. The final section of analysis describes the volatility of issues and tools, and the relationship between selected issues, and the number of issues addressed by the Colorado legislature each year.

## 5. Analysis of Non-Minor Water Laws in Colorado (1931 to 2006)

### 5.1 Era Analysis of Laws, Issues, and Tools

#### 5.1.1 Increasing Rate of Laws Over Time

**Table 4** shows a summary of the non-minor laws passed between 1931 and 2006 that addressed water issues in Colorado. Four points are shown: a) the total number of years; b) the years with legislation; c) the number of laws and; d) the laws per total years in each era. The Colorado legislature passed water related laws more consistently (moving from legislation passed approximately every other year in from 1931-1965 to each year between 1985-2006) and at a higher rate over-time. In the most recent era (1985-2006), the number laws passed per year was greater than 2 times any other era. With the exception of Era 2(1951-1965), the number of laws passed per year increased over time. Era 2 dropped from 2.2 laws per year to 1.3 laws per year.

**Table 4. Water laws per decade and era.**

<b>Era Span</b>	<b># of Years</b>	<b># of Years with Legislation</b>	<b># of Laws</b>	<b>Laws per Year</b>
1931-1950	20	11	43	2.2
1951-1965	15	8	18	1.2
1966-1984	19	14	47	2.5
1985-2006	22	22	118	5.4
<b>Total</b>	76	55	226	3

#### 5.1.2 Increasing Issues and Decreasing Attention to Allocation and Authority

**Table 5** below shows the number of times and percent each issue was addressed by the Colorado legislature in the non-minor laws passed between 1931 and 2006. ‘Water Allocation’ was the leading issue in water policy enacted between 1931 and 2006, and

‘Species or habitat protection’ and ‘Watershed restoration or enhancement’ were the least addressed issues.

**Table 5. Count and percent volume of water policy issues.**

	Water Allocation	Authority or Powers of an Agency or District	Other:	Water Storage	Water Quality	Species or Habitat Protection	Watershed Restoration or Enhancement
<b>Total</b>	114	62	61	23	20	8	1
<b>Percent</b>	39.40%	21.50%	21.10%	8.00%	6.90%	2.80%	0.30%

Over time, however, ‘Water Allocation’ was not consistently the primary water issue addressed by the State Legislature. **Table 6** shows the percent each issue was addressed when compared to all other water issues addressed per era. By employing the modified Frank et al (2011) eras, and comparing the percent that each issue was addressed in each era, a shifting of issue-focus of the laws was illuminated.

**Table 6. Policy issue percent by era.**

Era	Era Span	Authority or Powers of an Agency of a District	Water Allocation	Water Storage	Water Quality	Species or Habitat Protection	Watershed Restoration or Enhancement
<b>1</b>	<b>1931-1950</b>	30.6%	33.9%	12.9%	4.8%	0.0%	0.0%
<b>2</b>	<b>1951-1965</b>	16.7%	62.5%	4.2%	0.0%	0.0%	0.0%
<b>3</b>	<b>1966-1984</b>	25.0%	39.1%	12.5%	14.1%	4.7%	0.0%
<b>4</b>	<b>1985-2006</b>	15.6%	37.6%	4.3%	5.7%	3.5%	0.7%

**Note:** The percent each issue was addressed per era. The peak period of each issue are highlighted.

The trends in Table 6 highlighted four points about Colorado’s water policy issues:

1. The number of issues addressed by non-minor laws increased over time.



- a. The number of total unique issues addressed (excluding 'Other') in each era were:
  - i. 4 Issues in Era 1 (1931-1950).
  - ii. 3 Issues in Era 2 (1951-1965).
    1. 'Water Quality' issues were not coded in any non-minor laws.
  - iii. 5 Issues in Era 3 (1966-1984).
    1. 'Water Quality' issues re-appeared as well as 'Species or Habitat Protection'.
  - iv. 6 Issues in Era 4 (1985-2006).
    1. 'Watershed Restoration or Enhancement' was coded as an issue in non-minor laws for the first time.
2. Individual issues wax and wane in popularity over time.
  - a. For example 'Water Allocation' issues made up approximately 34% of all issues addressed in the non-minor laws in Era 1, then 63% in Era 2, then dropped back to 39% in Era 3.
3. The two most prominent issues, 'Water Allocation' issues and 'Authority or Powers of an Agency or District', had an inverse relationship in percent-change between eras.
  - a. Each era, in which one of the issues increased, the other decreased.<sup>8</sup>
4. 'Water Allocation' and 'Authority or Powers of an Agency or District' issues lost dominance in the last era.

---

<sup>8</sup> More detail of the inverse relationship between 'Authority or Powers of an Agency or District' and 'Water Allocation' issues is given in **5.3.1 Oscillations between Water Allocation and Authority Issues.**

- a. Between Era 1 and Era 3 the two issues accounted for between 64% and 79%. In Era 4, the two issues accounted for only 53% of all issues.

The tools used to address the water policy issues also expanded and shifted in use over time.

### 5.1.3 Increasing Tool Use by Era

**Table 7** shows the percent each type of policy tool was used when compared to all tools used between 1931 and 2006. Calculations were completed for both ‘all tools’ and ‘primary tools’ and the percent-use of each tool type as the ‘primary tool’.

**Table 7. Count and percent volume of all water policy tools and primary tools.**

		Regulation	Finance	Information Collection and Planning	Defines or Recognize Property Rights in Water	Monitoring Water Rights or Water Quality	Enforcement of Laws	Public Works or Infrastructure	Permits
<b>All Programs</b>	<b>Total</b>	128	80	70	49	43	39	35	28
	<b>Percent</b>	25%	16%	14%	10%	9%	8%	7%	6%
<b>Primary Program</b>	<b>Total</b>	70	23	24	22	12	4	26	13
	<b>Percent</b>	34%	11%	12%	11%	6%	2%	13%	6%
<b>Percent Use as Primary Program</b>		55%	29%	34%	45%	28%	10%	74%	46%

Note: The total number and percent of all tools used and primary tools used to address water issues in the laws passed by Colorado State Legislature between 1931 and 2006. Also shown are the percent that each tool was the primary tool based on the total number of times the specific tool was used as either the primary or supplementary tools.

These calculations showed:

1. Some tools have been used significantly more than others.
  - a. For example, ‘Regulation’ tools were used 25% of the time when compared to all tools employed in the water laws passed between 1931 and 2006, while ‘Permit’ tools were only used 6% of the time.
2. Some tools, when used, were normally the ‘primary tools’ while others were not.

- a. For example ‘Public Works or Infrastructure’ was used as the primary tool 74% of the time and ‘Enforcement’ tools were only used 10% of the time as the primary tool.

**Table 8** shows the percent each unique tool was used when compared to all tools used in the era. **Table 9** shows the percent each primary tool was used in the era. Tools, split into eras, show large variation in use. While ‘Regulation’ tools consistently held the most commonly employed tool in each era, other tools gained in popularity. Of the eight tool categories, less than half normally made up the majority of tools used in the early eras. Overtime, the percent use of tools flattened.

**Table 8. Policy tool (all tools) percent by era.**

Era Span	Finance	Enforcement	Regulation	Information Collection and Planning	Property Rights	Permits	Public Works or Infrastructure	Monitoring
1931-1950	19%	9%	31%	14%	10%	1%	1%	2%
1951-1965	14%	12%	26%	17%	14%	5%	0%	0%
1966-1984	9%	11%	35%	6%	15%	6%	5%	10%
1985-2006	18%	5%	20%	17%	7%	7%	11%	12%

The ‘all tool’ percent-use per era comparisons in Table 8 showed:

1. Policy tool use fluctuated over time.
  - a. For example ‘Regulation’ tools were used between 35% and 20% of the time and ‘Information Collection and Planning’ tools were used between 6% and 17% of the time, over the four eras.
2. All policy tool groups that were in use in Era 1 were in use in Era 4, but over time the scarcely used tools from the first eras were used more consistently during the later eras.

- a. For example, ‘Permits’, ‘Public Works or Infrastructure’, and ‘Monitoring’ tools were used at most 2% of the time in Era 1 and between 7% and 12% in Era 4.

The primary tool used to address the issues of each non-minor law gave a similar, but more pronounced comparison (**Table 9**): fewer tools were used as the primary tool in Era 1 than in Era 4, and a single tool no longer dominated the legislature. The highlighted cells show the peak use of each individual tool when used as the primary tool.

**Table 9. Policy tool (primary tools) percent by era.**

Era Span	Finance	Enforcement	Regulation	Information Collection and Planning	Property Rights	Permits	Public Works or Infrastructure	Monitoring
1931-1950	12%	0%	50%	14%	10%	0%	0%	2%
1951-1965	17%	0%	39%	17%	17%	0%	0%	0%
1966-1984	7%	0%	41%	7%	18%	0%	5%	14%
1985-2006	12%	4%	24%	12%	7%	13%	24%	5%

The patterns illuminated by the ‘all-tool’ analysis are more pronounced when the ‘primary tools’ were the focus. The primary tool analysis highlighted the following trends:

1. The tools used most often as the primary tool shifted over time and the variety of tools used increased over time
  - a. During Era 1, ‘Regulation’ was used 50% of the time and ‘Enforcement’, ‘Permits’ and ‘Public Works or Infrastructure’ tools were not used as the primary tool to address policy issues. By Era 4 ‘Regulation’ use dropped by nearly 50% and ‘Enforcement’, ‘Permits’, and ‘Public Works or Infrastructure’ use increased collectively to 41% of the primary tools used by the state legislature to address water policy issues.

Finally, comparing **Table 8 and Table 9**, the use of a tool as the primary policy tool did not always peak at the same time period as the tool's total use.

1. For example, 'Enforcement' tools were not used as the primary tool until Era 4 (1985-2006), when they accounted for 4% of all primary tools, but they had accounted for approximately 10% of all tools used in Eras 1, 2 and 3.

The relationship between policy issues and tools was also of interest. To answer the question of how certain issues were addressed by the legislature, tests of correlation were completed for each law passed, grouped by era.

#### **5.1.4 Relationship Between Policy Issues and Tools**

**Table 10** shows the results of the crosstab analysis between policy issues and tools in a passed non-minor law, grouped by era. Positive Phi values with a significance level below 0.10 (highlighted) indicated a strong relationship between the policy issue and tool. Over time, a single tool category had strong correlations with varying issues. For example, in only Era 1, 'Regulation' tools had a strong, positive correlations with 'Allocation' and 'Storage' issues, no significant positive correlations in Era 2 or 3, and then in Era 4 there were significant positive correlations with 'Quality' and 'Allocation' issues. Second, a particular issue was addressed by different tools over time. For example, the policy issue of 'Allocation' was addressed by various tools in each Era. These were:

Era 1: 'Regulation', 'Property Rights', and 'Enforcement' tools

Era 2: no strong correlations were identified

Era 3: 'Property Rights' tools

Era 4: 'Regulation', 'Property Rights', 'Permits', and 'Monitoring' tools.

**Table 10. Cross-tab analysis of issues and tools (all) by era.**

<b>Crosstab = Issue * Tool (all)</b>	<b>Era 1: 1931-1950</b>	<b>Era 2: 1951-1965</b>	<b>Era 3: 1966-1984</b>	<b>Era 4: 1985-2006</b>
	<b>Phi Value</b>	<b>Phi Value</b>	<b>Phi Value</b>	<b>Phi Value</b>
Allocation * Finance	-0.36**	-0.39	-0.33**	-.113
Allocation * Regulation	0.52***	-0.05	.137	0.26***
Allocation * Permits	0.16	0.16	.231	0.3***
Allocation * Information	0.28 <sup>#</sup>	-0.12	-.013	-0.19**
Allocation * Planning	-0.10	-0.20	-.172	-0.28***
Allocation * Property Rights	0.53****	0.32	0.40***	0.38****
Allocation * Enforcement	0.37**	-0.06	-.135	.038
Allocation * Monitoring	0.23		-.033	0.39****
Allocation * Public Works	-0.15		-0.37**	-0.39****
Quality * Finance	-0.16		-.052	-.004
Quality * Regulation	-0.18		.253	0.24**
Quality * Permits	-0.04		.138	.065
Quality * Information	-0.08		.165	-.091
Quality * Planning	0.28 <sup>#</sup>		.239	-0.16 <sup>#</sup>
Quality * Property Rights	-0.14		-.121	-.114
Quality * Enforcement	0.10		.211	.005
Quality * Monitoring	-0.06		0.54***	.145
Quality * Public Works	-0.04		.007	-.154
Storage * Finance	-0.01	-0.15	.129	.057
Storage * Regulation	0.35**	0.19	-.180	.028
Storage * Permits	0.32	-0.09	-.004	-.101
Storage * Information	0.10	-0.13	-.095	-.078
Storage * Planning	-0.12	-0.11	-.138	.032
Storage * Property Rights	0.34**	-0.17	.033	.009
Storage * Enforcement	0.39**	-0.15	-.006	.034
Storage * Monitoring	-0.11		-.235	-.051
Storage * Public Works	-0.07		.027	-.043

**Note:** \*\*\*\*p<0.001, \*\*\*p<0.01, \*\*p<0.05, \*p<0.10, #p<0.15. A positive Phi value indicates both the tool and the issue were present. A negative Phi value indicates one was present while the other was not. Blank cells indicate the particular policy issue and tool combination was not present. Significant relationships were not found in Era 2 because there were too few data points.

**Table 10 (Con't.). Cross-tab analysis of issues and tools (all) by era.**

Crosstab = Issue * Tool (all)	Era 1: 1931-1950	Era 2: 1951-1965	Era 3: 1966-1984	Era 4: 1985-2006
	Phi Value	Phi Value	Phi Value	Phi Value
Authority * Finance	0.55****	0.27	0.58****	-.062
Authority * Regulation	-0.23	0.15	.154	.101
Authority * Permits	-0.14	-0.19	-0.27*	-.032
Authority * Information	-0.24	0.04	-.151	-0.16 <sup>#</sup>
Authority * Planning	0.06	0.12	.103	-0.24****
Authority * Property Rights	-0.34*	-0.09	-.137	-.022
Authority * Enforcement	-0.18	-0.03	.197	0.3***
Authority * Monitoring	-0.20		-.154	-.137
Authority * Public Works	0.17		0.48***	-.021
Species or Habitat * Finance			-.109	-.165
Species or Habitat * Regulation			.136	.152
Species or Habitat * Information			-.055	-.071
Species or Habitat * Planning			-.080	-.034
Species or Habitat * Property Rights			-.004	.028
Species or Habitat * Enforcement			.246	.053
Species or Habitat * Monitoring			0.50***	0.16 <sup>#</sup>
Species or Habitat * Public Works			-.090	-.120
Species or Habitat * Permits			-.100	-.092
Watershed * Finance				.118
Watershed * Regulation				-.082
Watershed * Information				0.27 <sup>#</sup>
Watershed * Planning				.152
Watershed * Property Rights				-.039
Watershed * Enforcement				0.25 <sup>#</sup>
Watershed * Monitoring				-.055
Watershed * Public Works				-.053
Watershed * Permits				-.041
Other * Finance	-0.22	0.57*	-.088	0.2*
Other * Regulation	-0.24	0.28	-.148	-0.32****
Other * Permits	-0.09	1***	-.081	-0.26***
Other * Information	-0.16	0.24	0.48*	0.31***
Other * Planning	0.18	-0.16	0.69***	0.49****
Other * Property Rights	-0.04	0.5*	.071	-0.24***
Other * Enforcement	-0.28*	0.18	-.123	-0.24***
Other * Monitoring	-0.13		.148	-0.36****
Other * Public Works	-0.09		.269	0.47****

**Note:** \*\*\*\*p<001, \*\*\*p<0.01, \*\*p<0.05, \*p<0.10, #p<0.15. A positive Phi value indicates both the tool and the issue were present. A negative Phi value indicates one was present while the other was not. Blank cells indicate the particular policy issue and tool combination was not present.

**Table 11** summarizes the tools with significant correlations to any water issue per era. Over time, the number of tools with significant positive correlation to specific issues over time increased.

**Table 11. Tools with significant, positive correlations to water issues in each era.**

Programs	Era 1	Era 2	Era 3	Era 4
	1931-1950	1951-1965	1966-1984	1984-2006
Finance	X	X	X	X
Property Rights	X	X	X	X
Regulation	X			X
Enforcement	X			X
Permits		X		X
Monitoring			X	X
Information			X	X
Planning			X	X
Public Works			X	X

In summary of **Table 10** and **Table 11**, the cross-tab analysis between policy issues and the ‘all tools’ used to address the issues in each law, grouped by era, illuminated a number of characteristics between issues and tools:

1. The relationships between certain issues and tools changed in over time. While many years had issues associated with all types of tools, there were favored tools in a time period for certain issues.
  - a. For example, ‘Regulation’ tools had a strong, positive relationship with ‘Allocation’ and ‘Storage’ issues in only Era 1 and then with ‘Quality’ and ‘Allocation’ issues in only Era 4.
2. The number of strong, positive relationships a certain policy issue had with policy tools changed over time.
  - a. ‘Authority or Powers of an Agency or District’ issues had strong, significant correlations with ‘Finance’ tools in Era 1, ‘Finance’ and ‘Public Works or Infrastructure’ in Era 3, and ‘Enforcement’ in Era 4.



- b. 'Allocation Issues' were addressed by 'Regulation', 'Property Rights', and 'Enforcement' tools in Era 1, no strong correlations were seen in Era 2, 'Property Rights' tools in Era 3, and 'Regulation', 'Property Rights', 'Permits', and 'Monitoring' tools in Era 4.
- 3. The variation of tools used, or the number of tools with significant positive correlations, increased over time.
  - a. Era 1 had four tools with significant positive correlations with particular issues, Era 2 had three, Era 3 had six, and Era 4 had nine.

#### **5.1.5 Relationship Between Policy Issues and Primary Tools**

To further focus the relationship discussion between policy issues and tools, the primary tool of each law was used. Correlation tests were not completed because the number of primary tools was much lower than the number of 'all tools', which limited the statistical power. Therefore, a simple tally of the primary tools used per issue across the eras was completed. **Table 12** shows the number of laws that addressed certain issues used various tools over time<sup>9</sup>.

---

<sup>9</sup> Note: Because the advantage of a greater N was not present in this analysis, the tools were not grouped as they were before and so more tool categories are present

**Table 12. Count of primary policy tool used with each issue across eras**

<b>Allocation</b>	<b>Era 1</b>	<b>Era 2</b>	<b>Era 3</b>	<b>Era 4</b>
<b>Total Tool Types</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>10</b>
Regulations	13	7	13	11
Property Rights	4	3	8	6
Planning	1	1	1	2
Monitoring	1		1	4
Elections	1			
Information		1		
User Fees		1		
Construction Fund			1	
Markets			1	
Bonds				1
Enforcement				2
Grants / Loans				1
Permits				12
Public Works				3
Not Selected	1			11
Not Applicable		2		
<b>Authority</b>	<b>Era 1</b>	<b>Era 2</b>	<b>Era 3</b>	<b>Era 4</b>
<b>Total Tool Types</b>	<b>6</b>	<b>3</b>	<b>9</b>	<b>8</b>
Regulations	8	1	5	8
Bonds	3		3	1
Elections	2			
Employee Compensation	1			
Planning	3		1	
Taxes	2	2		
Information		1		
Appointments To Board			1	
Civil Service			1	
Construction Fund			1	
Markets			1	
Monitoring			2	
Public Works			2	3
Property Rights				1
Enforcement				2
Grants / Loans				2
Permits				2
Not Selected				3

**Table 12 (Con't.). Primary policy tool used with each issue across eras**

<b>Quality</b>	<b>Era 1</b>	<b>Era 2</b>	<b>Era 3</b>	<b>Era 4</b>
<b>Total Tool Types</b>	<b>2</b>	<b>0</b>	<b>3</b>	<b>5</b>
Regulations	1		3	4
Planning	2		1	
Monitoring			5	1
User Fees				1
Permits				1
Not Selected				1
<b>Storage</b>	<b>Era 1</b>	<b>Era 2</b>	<b>Era 3</b>	<b>Era 4</b>
<b>Total Tool Types</b>	<b>2</b>	<b>1</b>	<b>4</b>	<b>6</b>
Regulations	6	1	4	1
Property Rights	2		2	
Construction Fund			1	
Public Works			1	1
Bonds				1
Planning				1
Taxes				1
Not Selected				1
<b>Species Or Habitat</b>	<b>Era 1</b>	<b>Era 2</b>	<b>Era 3</b>	<b>Era 4</b>
<b>Total Tool Types</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>4</b>
Monitoring			3	
Regulations				2
Enforcement				1
Planning				1
Not Selected				1
<b>Watershed</b>	<b>Era 1</b>	<b>Era 2</b>	<b>Era 3</b>	<b>Era 4</b>
<b>Total Tool Types</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>
Grants / Loans				1
<b>Other</b>	<b>Era 1</b>	<b>Era 2</b>	<b>Era 3</b>	<b>Era 4</b>
<b>Total Tool Types</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>9</b>
Regulations	5	2		8
Planning	3			8
Elections	3			
Monitoring			1	
Information			1	1
Public Works				20
User Fees				3
Grants And-Or Loans				2
Bonds				1
Property Rights				1
Education				1
Not Selected				1

**Table 12 Note:** more than one issue could be present in each law and therefore in the table a primary tool is counted for each issue that was coded.

Table 12 described two trends of the relationship between policy issues addressed and primary tools used in non-minor water legislation between 1931 and 2006:

1. An issue was associated with a varied and increasing number of tools
2. For a given issue, a few tools were consistently used in each era as the primary tool while other policy tools were only used in certain time periods with that particular issue
  - a. For example, 'Regulation' tools were used in laws that addressed 'Allocation', 'Authority', or 'Storage' issues across every era, and laws coded for 'Authority' issues in Era 3 used almost a completely different set of tools than laws coded for 'Authority' issues in Era 4.

To examine how primary policy tools emerged and shifted over time, **Table 13** shows the first era that primary policy tools and issues were identified in the same law.

**Table 13. The first era which the issue and tool combination was observed**

'Primary Policy Tool'	Authority	Allocation	Storage	Quality	Species or Habitat	Watershed	Other
Regulations							
Planning							
Elections							
Bonds							
Taxes							
Employee Compensation							
Property Rights							
Information Collection	2	2					3
User Fees		2					
Monitoring	3			3	3		3
Construction Fund	3	3	3				
Markets	3	3					
Appointments To Board	3						
Civil Service	3						
Public Works	3		3				
Permits							
Enforcement							
Grants / Loans							
Education							

**Table 13 Note:** More than one issue could be coded at once and so, based on the coding methods; it is not possible to know if the primary tool was for applied to all issues present in the law or only a subset of all issues present.

Table 13 highlighted three patterns:

1. New tools were introduced over time for all issues (e.g. 'permit', 'enforcement' and 'grant or loan' tools all emerged in Era 4).
2. Over time, laws that addressed particular issues used different tools over time (e.g. Laws that addressed 'Authority' issues first used 'Regulation' and 'Planning' tools in Era 1 and then in Era 3 and 4 new issues were introduced in laws with 'Authority' issues).
3. A tool that was used in Era 1 for one issue may not have been used in a law that addressed another issue until a later era (e.g. 'property rights' was first used in Era 1 in laws containing 'Allocation' and 'Storage' issues and first used in Era 4 with laws containing 'Authority' or 'Other' issues).

The era analysis was useful to describe policy issues addressed by the State Legislature between 1931 and 2006, and the tools they used to address the issues. The preceding analysis illustrated the following about non-minor water laws:

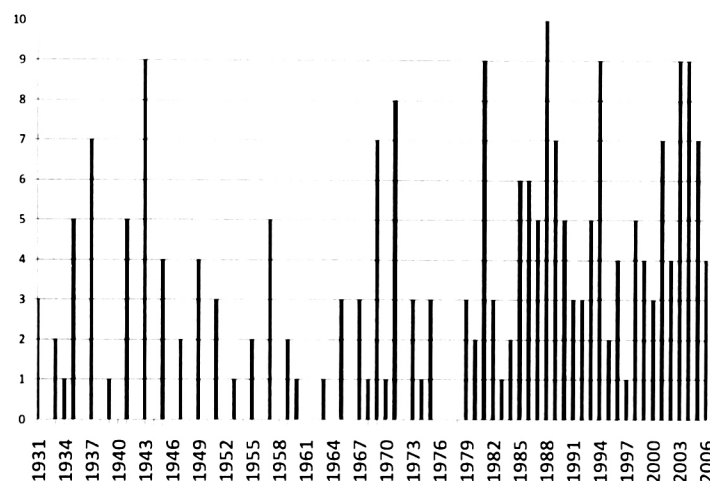
1. The rate that non-minor laws relating to water issues were passed increased over time.
2. Issue focus shifted over time. Issues such as 'Allocation' and 'Authority' dominated the water laws in the first few eras, but their overall percent use decreased as environmentally focused issues emerged.
3. 'Allocation' and 'Authority' issues percent use increase and decreased contrariwise to each other.
4. Policy tool use shifted over time. The most common policy tool to address water policy issues in Era 1 was 'Regulation' but, over time, a wider variety of tools were used both in general and as the primary tool.
5. New policy tools emerged over time, but old tools were still utilized.
6. Specific water policy issues were addressed by different, and in some cases, more tools over time

The era analysis' strength of summarizing shifts over a large period of time is also its limitation. The number of laws passed and the percent each policy issue and tool made up each year's worth of laws were volatile. Furthermore, the relationship between 'Allocation' and 'Authority' issues needed a more granular analysis to determine if the inverse relationship seen in the era analysis was coincidence or not. The next section examines the non-minor laws, policy issues, and tools by year to explain the nuances that the era analysis could not.

## 5.2 Year to Year Fluctuation and Increase of Water Laws, Issues, and Tools

### 5.2.1 Increasing Regularity of Years with Passed Water Laws

**Figure 1** below shows the yearly number of water related laws passed during years with legislation. Up until the end of the 1970s, water related laws were not passed regularly. Between 1931 and 1967 water related laws were passed every 2 years. From 1968 to 1979 laws were passed in consecutive years but there were multiple years that did not have any water laws passed. Only after 1979 were water laws were passed each year. Every year that water legislation was passed, there were, on average, 4 laws which dealt with one or more water issue.



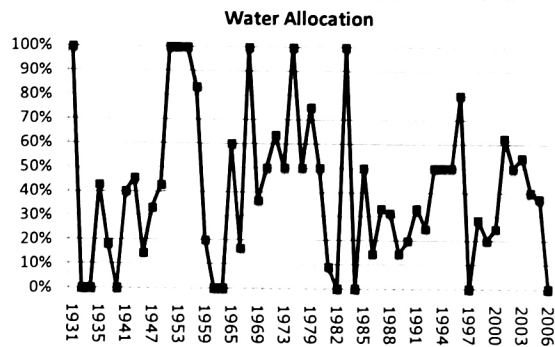
**Figure 1. Water Laws Per Year**

As described in section 5.1.2, new issues were addressed over time, but what the era analysis could not describe was any volatility within the eras.

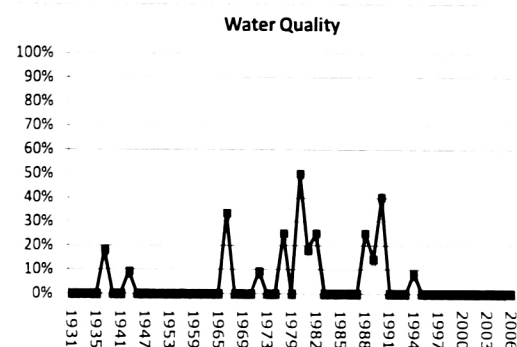
### 5.2.2 Issues Fluctuate and Authority and Allocation Issues Compete

**Figures 2** through **4** described the percent that the individual issues of 'Water Allocation', 'Authority or Powers of An Agency or District' and 'Water Quality' were

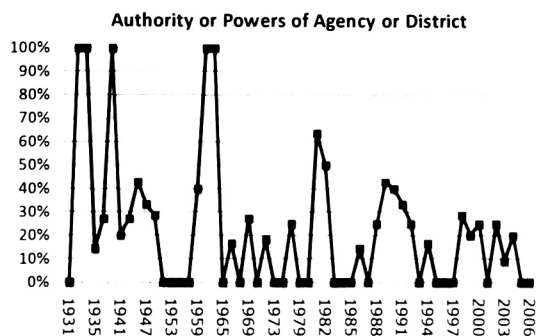
addressed for every year non-minor water policy was enacted. . APPENDIX C shows the yearly percent use of the remainder of issues coded in the study



**Figure 2. Water Allocation Percent By Year.**



**Figure 4. Water Quality Percent By Year.**



**Figure 3. Authority Or Powers Of An Agency Or District Percent By Year.**

**Note:** Each figure shows the individual issues percent. For example in 1984 the total number of issues coded was 2. 1 of those was the issue of 'Water Storage', therefore 'Water Storage' made up 50% of the issues that year.



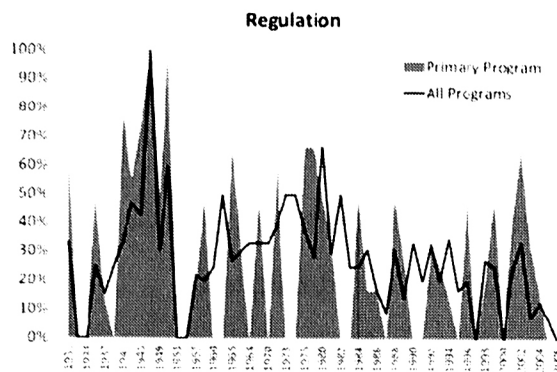
**Figure 2 - 4** convey the following points about water policy issues on a year-to-year basis:

1. Policy issues were volatile; an issue dominated the focus of the laws passed in one year and then was not addressed the next year.
  - a. For example, 'Water Allocation', **Figure 2**, made up 100% of issues addressed in 1931, 1951, 1953, 1955, 1968, 1974, and 1983, then significantly dropped off the agenda following year those years.
2. Some issues stay at a low level most of the time and then in a few instances make up for the majority of issues addressed in one year.
  - a. For example, 'Water Quality', **Figure 4**, made up 50% of the policy issues addressed by the Legislature in the early 80s and was not addressed at all in the 50s or 2000s.
3. The inverse relationship between 'Water Allocation' and 'Authority' issues is consistent at the year-level analysis.

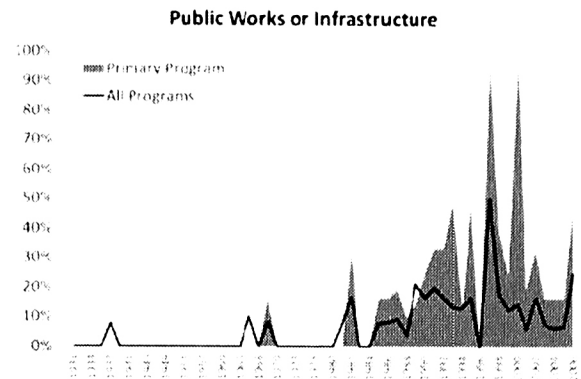
### **5.2.3 Tool Volatility and Emergence of New Primary Tools**

The 'all tool' percent and primary tool percent per year for 'Regulation' 'Enforcement of Law' and 'Public Works or Infrastructure' are shown in the following three figures(**Figure 5-6**). The primary tool percent is depicted by the area graph and the 'all tool' percent is shown by the line graph. **APPENDIX D** contains every tool group figures.

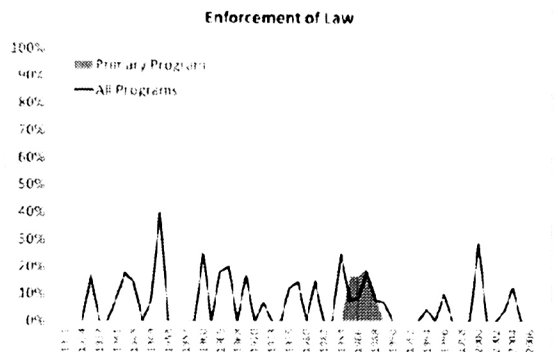
a.



**Figure 5. Regulation Percent Use.**



**Figure 7. Public Works/Infrastructure Percent Use.**



**Figure 6. Enforcement Percent Use.**

Note: The primary tool percent use is depicted by the area graph and the 'all tool' percent use is depicted by the line graph.

**Figure 5-6** convey the following points about policy tools used in the non-minor laws that addressed water issues between 1931 and 2006:

1. Tool use was volatile.
  - a. For example, 'Regulation' use as a tool and primary tool ranged from a 100% to 0%.
2. Some tools were present every year but had periods in history where they were emphasized more.

- a. For example, 'Enforcement of Law' tools made up 40% of all tools used in 1951, but were below 20% for the majority of the time period examined.
- 3. Tools emerged over time.
  - a. For example 'Public Works or Infrastructure' tools were not used consistently until 1982.
- 4. Tool percent use as the primary tool does not correlate with its percent use as supplementary tool.
  - a. For example, 'Enforcement' of Law' was use throughout the time period, but only used as the primary tool in the 1980s

The year to year analyses of non-minor laws, their issues, and the tools used by the legislature to address them, illustrated high volatility of even the most popular issues and tools. The year to year analyses also reinforced the era analyses' conclusions that policy issues emerged over time, 'Authority or Powers of an Agency or District' and 'Allocation' issues competed for focus, and over time, a wider variety of policy tools was used.

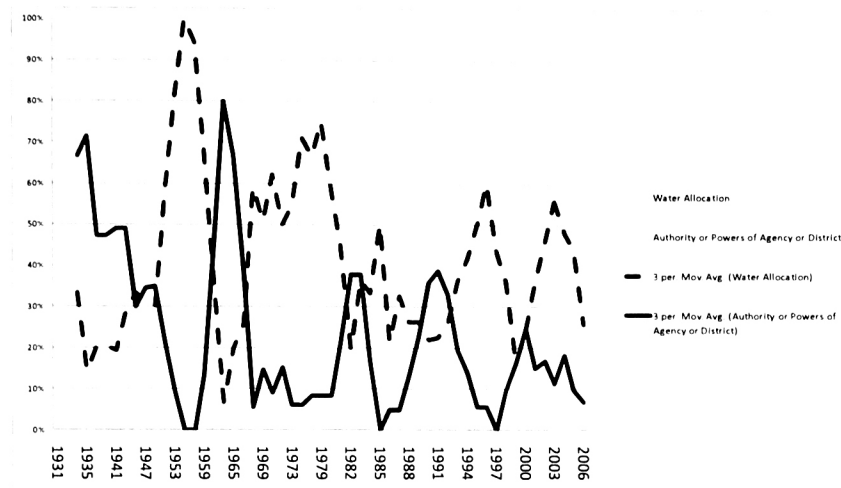
The next section uses both era and year-to-year analyses to calculate the volatility of policy issues and tools, the oscillation between 'Authority or Powers of an Agency or District' and 'Allocation' issues, and demonstrate the limited, but expanding capacity of the State Legislature to focus on policy issues.

### **5.3 Issue Oscillation, and Legislature Issue Capacity**

#### **5.3.1 Oscillations between Water Allocation and Authority Issues**

The era and year to year analysis of the percent an issue was addressed in non-minors laws demonstrated an inverse, oscillating relationship between 'Authority or Powers of an Agency or District' and 'Water Allocation'. **Figure 8** highlights the pattern between the issues of 'Authority or Powers of an Agency or District' and 'Water Allocation' by comparing

a three-period moving average of the two issues. A Pierson's R Correlation of the yearly issue percent dominance between the two demonstrated a strong negative correlation of -0.64.<sup>10</sup>



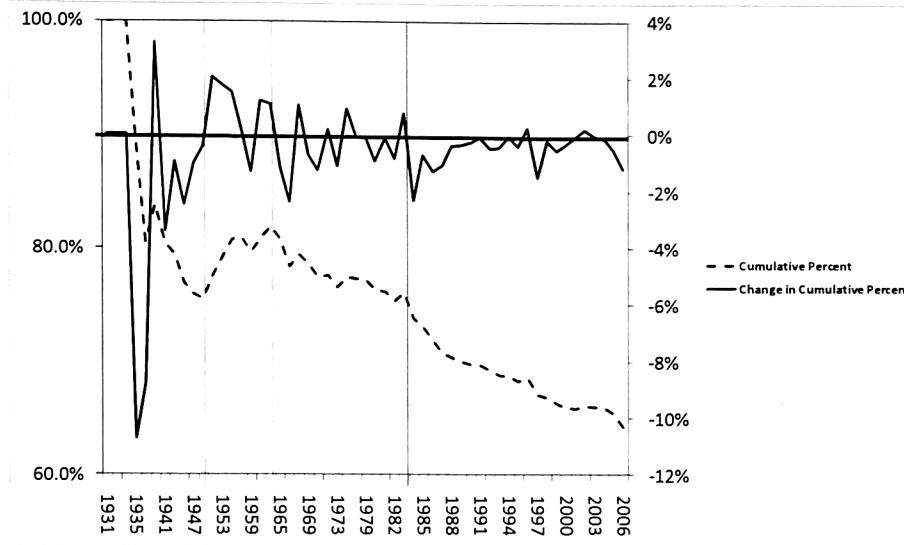
**Figure 8. Three-Period Moving Average Of Authority And Allocation Issues By Year.**

In addition to the inverse relationship of 'Authority or Powers of an Agency or District' and 'Water Allocation' issues, the use of both issues declined over time. The decreasing dominance is revealed in **Figure 9** and by independent paired t-tests of the yearly combined percent-use of the two issues before and after the beginning of Era 4 (1984).

<sup>10</sup> Pierson's R Correlation for selected issue combinations were:

	Water Allocation	Authority	Water Storage	Water Quality	Species or Habitat Protection
Water Allocation	1	-0.64	-0.1	-0.18	-.33*
Authority	-	1	-0.21	0.07	0.26
Water Storage	-	-	1	-0.22	0.03
Water Quality	-	-	-	1	0.2
Species or Habitat Protection	-	-	-	-	1

\*Species or Habitat Protection correlations used percent use per year from 1968-2006, rather than 1931-2006.



**Figure 9. Cumulative Percent Of 'Water Allocation' And 'Authority' Issues By Year.**

Note: The vertical lines along the time line indicate each era, the solid line is the year over year change in cumulative percent, and the dotted line is cumulative percent use.

The dotted line in **Figure 9** demonstrated that the cumulative average percent of water allocation and authority issues over time decreased from 100% in 1931 to 64% in 2006. Following the cumulative average (dotted line); Era 2 (1951-1965) had the largest increase in cumulative average percent, and then in Era 3, the cumulative average percent dropped consistently. The negative slope increased in Era 4 (1985-2006). The majority of change in cumulative percent (solid line) the years in Era 2 were positive, indicating an increase in the percent of issues related to 'Authority of an Agency or District' and 'Water Allocation'. In Era 3 the year over year changes averaged more negative than positive, and in Era 4, the year over year changes were predominately negative.

The increased negative slope of average cumulative percent (dotted line), beginning in 1984, indicated a shift away from the issues of 'Authority or Power of an Agency or

District’ and ‘Water Allocation’. Between 1931 and 1984 the two issues, on average, made up for 73.8% of all water issues addressed in the water related laws passed by the Colorado State Legislature. Between 1985 and 2006, ‘Authority or Powers of an Agency or District’ and ‘Water Allocation’ issues averaged only 49.7% of all issues addressed. Independent t-test compared the year over year combined percent-use of ‘Water Allocation’ and ‘Authority or Power of an Agency or District’ issues to all other issues’ percent-use and confirmed the shift at 1984 was significant with a p-value < 0.001. The shift in means between Era 3 and Era 4 (1966-1984 compared to 1985-2006) was 64% to 50% with a p-value = 0.05.

In conclusion, ‘Authority or Power of an Agency or District’ and ‘Authority’ percent use dropped significantly in Era 4 as other issues gained traction.

### 5.3.2 Increasing Attention Capacity of Issues at the State Legislature

The individual issue percent use was grouped by decade, and then a percent change in use between decades was calculated (results shown **Table 14**).

**Table 14. Policy issue percent change by decade.**

Decade Span	Authority or Powers of an Agency or District	Water Allocation	Water Storage	Water Quality	Species or Habitat Protection	Watershed Restoration or Enhancement
1931-1939	NA	NA	NA	NA	NA	NA
1940s	-13%	<b>26%</b>	<b>89%</b>	-68%	0%	0%
1950s	-59%	<b>92%</b>	-100%	-100%	0%	0%
1960s	<b>104%</b>	-49%	<b>2000%</b>	<b>800%</b>	<b>400%</b>	0%
1970s	-48%	<b>74%</b>	-38%	<b>4%</b>	-100%	0%
1980s	<b>113%</b>	-60%	-75%	<b>88%</b>	<b>630%</b>	0%
1990s	-32%	<b>60%</b>	<b>28%</b>	-62%	-4%	<b>200%</b>
2000-2006	-43%	<b>7%</b>	<b>53%</b>	-100%	-100%	-100%

A positive percent change (highlighted cell in **Table 14**) represents an issue which was addressed more in the current decade than in the previous. The majority of the time, the number of issues that gained in strength in a decade is balanced by the number of issues that lost strength. The outlier to this pattern was from the 1940s to the 1950s when there was one positive change and three negative changes, when ‘Water Allocation’ issues increased by 92% and all other issues decreased, and then from the 1950s to the 1960s, when there were four positive changes and one negative change when ‘Water Allocation’ issues dropped by 49% and all other previously addressed issues experienced greater than 100% increases. Once again, an oscillation of issues was present. Additionally, the analysis indicated that the oscillation between issue focus in the non-minor laws is not limited to ‘Authority or Powers of an Agency or District’ and ‘Water Allocation’ issues. The oscillation appears among all issues.

In addition to issues shifting and oscillating over time, the number of issues addressed per year changed over time. **Table 15** shows the results of the independent sample t-tests of the average number of unique issues addressed per year between eras.

**Table 15. Number of unique issues addressed per year by era.**

Era	Span	Mean	Mean Comparison	
			Test	p-value
Era 1	1931-1950	2.64		
Era 2	1951-1965	1.5	Era 1 v. Era 2	0.034
Era 3	1966-1984	2.43	Era 2 v. Era 3	0.045
Era 4	1985-2006	3.09	Era 3 v. Era 4	0.121
Era 1, 2, and 3	1931-1984	2.15	Era 1, 2, and 3 v. Era 4	0.015

The shifts from era to era were significant at a 0.05 level of significance except for the average number of shifts between Era 3 and Era 4; meaning the increase in number of issues addressed from an average of 2.43 in Era 3 to 3.09 in Era 4 was within the natural

variation found in the data. The final test (row 5) in **Table 15**, demonstrated that the average number of issues addressed in the non-minor laws in Era 4 (1985-2006) was higher than the rest of the data set (1931-1984).

Combining the year and era-level analysis gave a better understanding of the Colorado State Legislature's non-minor water laws passed between 1931 and 2006. **Table 6** and **Table 14** above both demonstrated that the number of unique issues addressed by the Colorado State Legislature increased with time. **Table 15** calculated the total number of unique issues addressed per year for each era, demonstrating through calculation, what the other analyses had through observation: the number of coded issues addressed each year in the non-minor laws passed by the legislature between 1931 and 2006 increased. **Figure 2-4** demonstrated that issues, at the year to year level, were not addressed every year. **Figure 8** and the Pierson's R correlation between the two most addressed issues, 'Authority' and 'Allocation', also demonstrated that water policy issues are not addressed each year and when one popular issue was addressed more in a year, the other was addressed less.



## 6. Conclusions and Discussion

The preceding analysis allows each hypothesis to be addressed and discussed:

### 6.1 Issues Relating To Water Issues Will Shift Over Time

The data analysis of the percent number of specific issue codes found in each non-minor law between 1931 and 2006, highlighted in **Table 6**, supported the hypothesis that issues will shift over time. The **Table 6** demonstrated two trends:

1. An individual issue will have large swings in percent use
2. 'Allocation' and 'Authority' issues' cumulative percent use dropped and environmental issues increased over time.

The shift in issues away from 'Allocation' and 'Authority' was further demonstrated by **Figure 8**, and **Figure 9**, where the total cumulative percent of the two issues drops when other issues were addressed by the state laws. This shift in focus toward environmental issues is congruent with the literature.

### 6.2 The Legislatures Limited Issue Capacity

The inverse relationship of 'Authority' and 'Allocation' issues also suggested a limit in the issue capacity of the legislature. Both issues made up a large percent of issues addressed in each era however, when one of the issues increased in percent the other decreased. **Figure 2** and **Figure 3** demonstrate that, at the year level, one of the two issues could make up 100% of all issues addressed in the non-minor laws one year, and the next year the other issue made up 100% of the issues addressed. This suggests 'Water Allocation' issues and 'Authority' issues competed for the limited attention state legislation. Further evidence to support the hypothesis that the state legislature is limited in the number of issues it can address at one time was given by **Figure 9** and by independent paired t-tests of the yearly combined percent-use of the two issues before and after the

beginning of Era 4 (1984). Both demonstrated the percent number of issues that addressed 'Allocation' and 'Authority' issues dropped as more issues were being addressed. From this it could be inferred that not only did different issues emerge over time but the new issues gained traction in the subsystem and took focus from the issues which previously held attention by the State Legislature. Finally, **Table 6**. Policy issue percent by era and **Table 15** demonstrated the number of unique issues addressed per year was roughly half of the unique issues addressed in the year's corresponding era. While the 'Other' category was also coded throughout the eras, and may have consisted of a variety of issues, the results based off of the six specific issues in the code book reflect the yearly agenda of the legislature was limited to fewer issues than the number of current issues addressed in the era and as the two environmental codes emerged, the number of other issues addressed in non-minor laws decreased.

### **6.3 The Legislature Increased Issue Capacity**

Three pieces of evidence support the hypothesis that the legislative capacity to focus on a limited number of issues increased over time. First, the rate at which non-minor laws were passed increased over time (**Figure 1**. Water Laws Per Year. Second, the number of issues addressed per era increased over time (**Table 6**). And last, the number of issues addressed per year significantly increased over time from 2.64 to 3.06 (**Table 15**). The decadal percent change in (**Table 14**) also suggests a limit that is increasing, with all but two decades showing an increase or decrease of issues in nearly equal amounts (limited capacity) and the number of positive and negative changes per decade increased from four in the 1930s to six in the 2000s (increased capacity).

### **6.4 Policy Tools Used By The Legislature Shift Over Time**

Analysis of 'all tools' used in the non-minor laws and the primary policy tool of the non-minor laws both demonstrated a shift in use over time. **Table 8** and **Table 9** highlighted

the shift of 'all tools' and primary tools from a few popular tool types, such as 'Regulation', 'Finance' and 'Information Collection and Planning' tools to like 'Permits' and 'Public Infrastructure'. The cross tab analysis between tools and issues (**Table 10**) and simple count of tool per issue per era (**Table 12**) demonstrated the non-minor laws that addressed water issues used different tools in more recent eras than in past eras. **Table 13**, which highlighted the first era which a specific policy tool was coded as the primary policy tool, described new tools like 'Enforcement' and 'Permits' emerged over time for all issues. These analysis all demonstrated that the legislature did not continue to address water issues with the same issues.

#### **6.5 Tools Used By The Legislature Increase In Variety**

Tool variation was revealed by a number of analyses. **Figure 5-6** conveyed each policy tool coded in the non-minor laws was volatile. **Table 8** and **Table 9** demonstrated that the scarcely used tools in Era 1 and 2 were used more often in Era 3 and 4. **Table 10** and **Table 11** both highlighted the number of policy tools with significant relationships with issues increased over time. And finally, **Table 12**, the described the primary tool use for most coded issues changed and increased over time.

#### **6.6 A Particular Issue Can Be Addressed By Different Tools**

The last hypothesis was that a specific policy issue would be addressed by different policy tools over time. Similar to sections 6.4 and 6.5, the analyses describing the relationship between policy issues and policy tools clearly gave evidence to this hypothesis. **Table 13**, which showed the first era that primary policy tools and issues were identified in the same law, summarized which tools were first used with each policy issue. **Table 12** describes the same information, but also demonstrated that even though some policy issue were addressed by new tools, they were also associated with some of the tools used in the past.

## 6.6 Discussion

In summary of each of these points and tests, Colorado's water policy issues are both persistent and emerging. Getting water to the right place at the right time, and allocating ownership over water will be continual issues, but as our understanding of ecology and hydrology increase, as our demand for water rises, and our values change, these issues are addressed differently now than in the past. Today we must consider environmental values and Native American Rights when making decisions around water issues. The tools used by the legislature have also shifted; they have move away from predominately using regulatory tools and toward enforcement and financial tools. Finally, Drawing upon the punctuated-equilibrium theory and the Advocacy Coalition Framework stated above, and given their assumption of the bounded rational actor (which states an collective decision making bodies, like individuals, is limited in its ability to focus and therefore breaks into subsystem which specialize on a smaller set of topics) implies at the lowest denominator of institution is therefore also limited to a number of foci. The increased number of water issues addressed by the Colorado State Legislature in their non-minor laws between 1931 and 2006 describes their limit to a subset of water issues present at the time. The legislature has increased its capacity to address more water issues through the creation of the Department of Natural Resources, the Colorado Division of Water Resources, empowering the state engineer, and creating the Colorado Water Conservation Board.

Another cause for a limit in the number of issues is political friction. Ingram (1990, 7-10) and Getches and Meyers (1986, 52-55) describe a policy monopoly during the first two-thirds of the 20<sup>th</sup> century in western water policy. During this time, policy makers and the politically powerful defined and approached the problem of water scarcity and detrimental flooding with large, federally funded, projects to create dams and reservoirs for the benefit of agriculture, municipalities, and industry (source). Voices of Mexican, Native

American, and environmental needs were not heard (Hundley 1986, 18) and alternate solutions were not implemented. The breakthrough of environmental issues in the later eras may not have been purely due to information processing limits, but due to the players involved and their values.

This is not to say the environment did not play a role early Colorado water policy. In fact, the environment played a major role in water issues in the 20<sup>th</sup> century. Grigg (2003, 16) stated that it was not “until after the droughts of the 1930s and 1950s” did the issue of “ground water law...become a priority” and Hundley (1986, 16-17) described a *fear* of flooding, not an actual flood, in California’s Imperial Valley (which might have swayed Congressional decisions in favor of California’s interest) as a major pressure to sign the 1922 compact. Today, as the secondary literature (Blomquist, 2004), (Hundley 1986) and (Getches and Meyers 1986) and Grigg (2003) describes, both drought and flood concerns, as well the environment’s health are influential to today’s water policy. These new concerns may have a part in the increased number of tools seen. Scholars in the 1950s contended “that the invention and utilization of a variety of tools would enable governments to solve social and economic problems without the intense cleavages and ideological debates that otherwise might occur” (Schneider and Ingram, 1990, 511). Schneider and Ingram (1990, 525) go on to say “Some states, countries, or historical eras may have adopted characteristic styles of policy change that have interesting implications for political stability as well as for policy effectiveness”. In this author’s interpretation, the policy tools used may be to find solutions between ideologies and try new methods to more effectively address old problems, now that new information and values are present. The data set, particularly Table 13, supports the hypothesis that certain time periods may have its own ‘characteristic style of policy change’ (through the use of new policy tools). Table 13 showed the water policy subsystem shifted from primary policy tools dominated by regulation and planning to more enforcement and monitoring tools in the later eras. Finance tools were present

throughout the time period but shifted from taxes and bonds to permits to grants or loans and user fees.

Salamon (2002, 3) describes recent policy tools used by the federal government, especially those in welfare, Medicaid, Medicare, and environmental cleanup and restoration as more hands off. Additionally, Salamon (2002, 3) says that third party involvement and discretion of public funds has increased since WWII. In other words “The United States “has changed its role from one of doing to one of arranging” (Salamon 2002, 8). The review of Colorado’s water policy change and management did not reveal this pattern. The number of tools and departments has increased, but those who physically allocate and regulate water and purchase and manage instream flow tools are still government employees (state engineer, district engineer and commissioners, water court officials). The state and its departments appear to be the major managers of water allocation and authority issues. It cannot be concluded from this research that the other policies directed at water quality, watershed restoration, and species or habitat protection issues or that the finance tools/tools used to address all issue types are carried out by non-state run agencies.

## **6.7 Future Work**

Future work on the Colorado policy data set could include examining state legislation from the 1900s to 1931 to give a more complete picture of Era 1’s issues and policy tools (currently 1931-1950). This would better represent the early era’s described by Grigg (2003), Sabatier et al (2005), and Frank et al (2011) all who begin an era near the turn of the 20<sup>th</sup> century.

The Colorado State legislature is one of many water policy venues in Colorado. Understanding the issues the other venues, such as the water courts, the CWCB, the state engineer’s office address without an act of the General Assembly, would provide a more

complete picture of Colorado's total water issues and tool shifts over time. A depiction of some of the major policy venues are shown in **APPENDIX E**.

This thesis sets up a good framework for continued work on the state level water policy data created by Dr. Schlager and Dr. Heikkila. The Heikkila-Schlager data set includes multiple states and similar studies of other western states could be completed and compared to this study to understand how water policy has changed over time within water basins and across state lines.

Once the *how* of water policy change is described the *why* could be addressed. Colorado's water subsystem could be candidate for the Advocacy Coalition Framework due to secondary literature's allusion to multiple and changing values over time. Research to understand how coalitions within the water policy subsystem have evolved over time may help to explain *why* water polices changed the way they did.

## APPENDIX A

### TIMELINE OF ERAS

U.S. Water Mangement	U.S. Watershed Management	Colorado Water Development	Colorado Issues and Solution Focus
Sabatier et al 2005	Schlager and Blomquist 2008	Grigg 2003	Frank et al 2011
The Manifest Destiny Era (pre-1890s)		Early Settlement, Initial Water Era (1830-1900)	Establishment of the Pure Appropriate Doctrine Era (1850-1900s)
The Progressive Era (1890-1924)		Water Development Era (1900-1950)	Shifting Focus Era (1900-1950)
The Federal/New Deal Era (1925-1964)	River Basin Development Era (1933-1965)		
The Environmental Era (1965-1986)	River Basin Commissions Era (1965-1980)	Law Tune-Up Era (1950-1975)	Redefining Boundaries Era (1951-1965)
	The Watershed Movement Era (1980s to 2007)	Environment, Regulation, Litigation Era (1975-2000)	Growing Conflicts Era (1965-1984)
The Collaborative Era (1987-present)		Growth, Efficiency, Environment Era? (2000-2050)	Cooperation Era (1985-2006)



## APPENDIX B

### CALCULATIONS

The calculations used to compare issues and tools over time are listed below.

#### *Year-to-Year Calculations*

1. Number of laws passed per year = count of each law with identical year code
2. Issue Breadth of each law = Total number of individual Issue codes = 1 per law
3. Total number of times a unique Issue was addressed per year = sum of TRUE = 1 value codes for each issue for all laws passed within identical years
4. Total number of all issues addressed in a year = Sum of Calculation 2 for all laws in the year = sum of 'Issue Breadth' for all laws sharing identical years. Or Sum of Calculation 3 for each issue = Sum of "total number of times a unique issue was addressed per year" for all issue codes
  - a. Note: A law could be coded for more than one issue. Therefore the 226 laws in the data set address 289 total issues.
5. The percent volume a unique issue was addressed each year = Calculation 3/Calculation 4 = (Total number of times a unique issue was addressed in a year) / (Total number of all issues addressed in a year)
  - a. This calculation highlights what issues were emphasized in the year
6. Absolute Distance between Year  $x$  and Year  $x-1$  with respect to Issue.
  - a. First a Value of TRUE = 1 was given to each issue in a given year if Calculation 3  $\geq 1$  = the 'Total number of times a unique issue was addressed per year' was  $\geq$  than 1.
  - b. Second the Absolute difference between Year  $x$  and Year  $x-1$  for individual issues was calculated by subtracting the Value of the 'Presence' of each unique issue from Year  $x$  from the value of the 'Presence' of that unique issuer in Year  $x-1$ .
  - c. Third, the sum of the difference of all individual issue 'Presence' values was calculated = Absolute difference between Year  $x$  and Year  $x-1$  for all issues
    - i. A value of 0 for year X would mean that the laws in year X and year X-1 addressed identical issues. A Value of 1 for year X shows that

there was a difference of 1 issue between year X and X-1. The greater the Value the more issue changes between the years.

7. The number of unique issues addressed per year = sum of Calculation 6a for all issues in a given year.

#### *Decade and Era Calculations<sup>11</sup>*

8. Total number of times a particular issue was addressed in a Decade or Era = sum of TRUE = 1 value codes for each issue for all laws passed within the Decade or Era
9. Total number of issues addressed in a Decade or Era = sum of Calculation 7 for each issue type
10. Issue dominance or 'rate' = Calculation 8/ Calculation 9 for each issue per decade or Era<sup>12 13</sup>
  - a. This calculation shows which issues were addressed most often and least often in the Decade or Era
11. Percent Change of issue dominance =
 
$$\frac{(\text{Issue } \gamma \text{ Dominance for Era } x+1 - \text{Issue } \gamma \text{ Dominance of Era } x)}{\text{Issue } \gamma \text{ Dominance of Era } x}$$
  - a. This calculation highlights the shift of focus between two Decades or Eras for each issue; it shows the movement on and off the agenda for each Issue between the decades or eras. For example if in decade 1, 8 laws addressed 10 issues and 2 of those issues were 'Water Quality' then 'Water Quality' made up 20% of the issues addressed that year. Then in decade 2, 'Water Quality' was not addressed in any of the laws within that decade the percent change would be -100%, or if the number of 'Water Quality' issues

---

<sup>11</sup> Identical calculations were conducted for 'Issues', 'All tools', and 'Primary Tool'.

<sup>12</sup> In the code book multiple issues and tools could be attributed to a single law so the denominator when calculating the percent of focus a particular issue or tool had in a given year was based on the total number of issues or tools addressed respectively, not the total number of laws passed in a year.

<sup>13</sup> Only a single 'Primary Tool' could be selected for each law but some laws' code for 'Primary Tool' was left blank and therefore the total number of 'Primary Tools' in a year was used as the denominator rather than the total number of laws in a year.

addressed was 4 out of a total of 20 issues addressed in decade 2, then the percent change would be 0.

12. Independent t-tests for comparing number of unique issues addressed per year
  - a. Number of unique issues addressed per year, grouped by varying time periods
  - b. SPSS was used to calculate if the difference of the number of issues addressed per year changed over time
    - i. Test Variable was the number of issues per year which were addressed (Calculation 3)
    - ii. Grouping Variable
      1. Dummy variables to split the data at varying points were used to compare if the number of unique issues addressed per year shifted

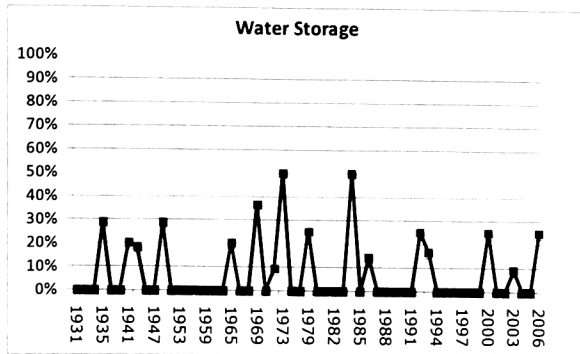
#### *Issue and Tool Relationship Calculations*

13. Correlation and test of symmetry
  - a. The presence per year of each individual Issue and Tool (0 if the issue or tool was not present and 1 if it was: Calculation 6a) was used as inputs into SPSS.
  - b. Crosstab setup
    - i. Issues were input as rows
    - ii. Tools were input as columns
    - iii. Eras were input as layers
  - c. Crosstab's were calculated with the following statistics
    - i. Chi-Square
    - ii. Correlations
    - iii. Phi and Cramer's V
  - d. Analysis metrics used
    - i. Significance: Fishers' Exact Test (2-sided) less than 0.1
      1. Less than 0.1 was considered a strong correlation between the issue and tool
    - ii. Symmetry: Phi-Value
      1. Positive Phi value is a positive correlation between the issue and tool, i.e. when one was present the other was also present.

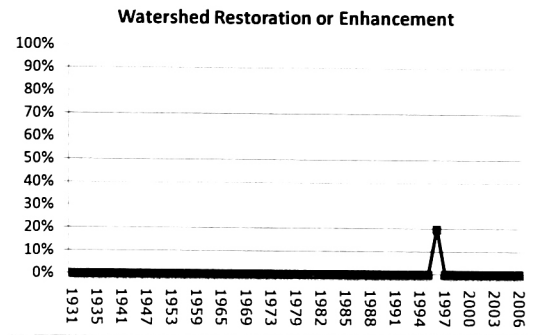
2. Negative Phi value is a negative correlation between the issue and tool, i.e. when one was present the other was not present.
14. Comparing the variability of issues and tools
  - a. Independent t-test
    - i. The distance between years from Calculation 6 for both issues and tools was used to compare the year to year variability of each code.

## APPENDIX C

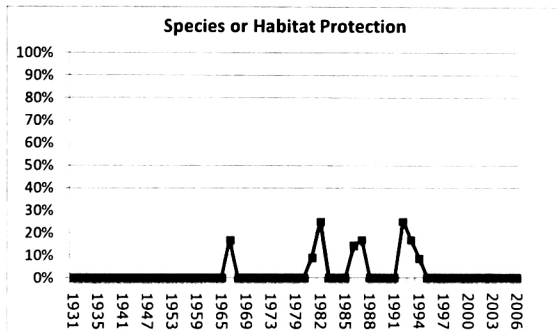
### YEARLY PERCENT OF WATER POLICY ISSUES



**Figure 10. Water Storage Percent By Year.**



**Figure 12. Watershed Restoration or Enhancement Percent By Year.**

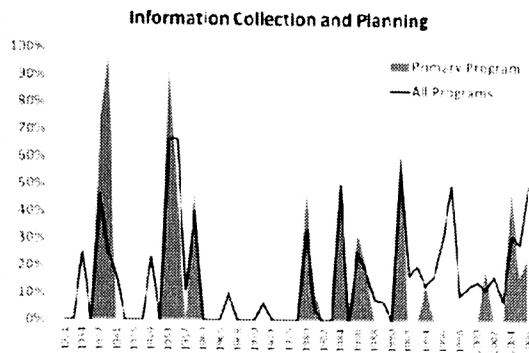


**Figure 11. Species Or Habitat Protection Percent By Year.**

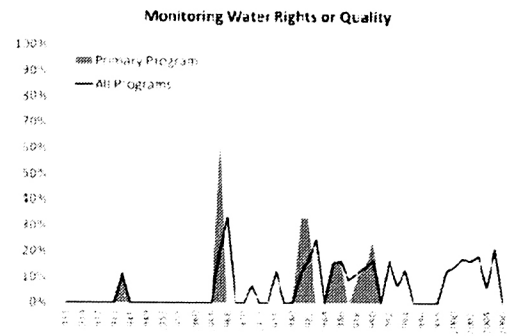
**Note:** Each figure shows the individual issues percent. For example in 1984 the total number of issues coded was two. One of those was the issue of 'Water Storage', therefore 'Water Storage' made up 50% of the issues that year.

## APPENDIX D

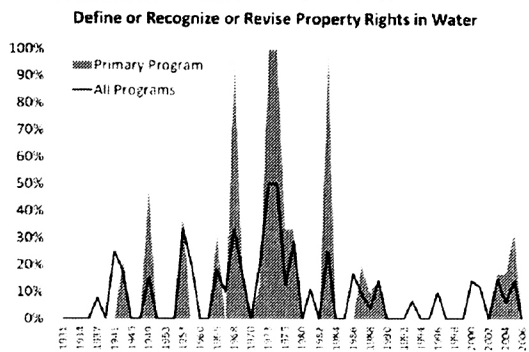
### YEARLY PERCENT OF PRIMARY TOOLS AND 'ALL TOOLS'



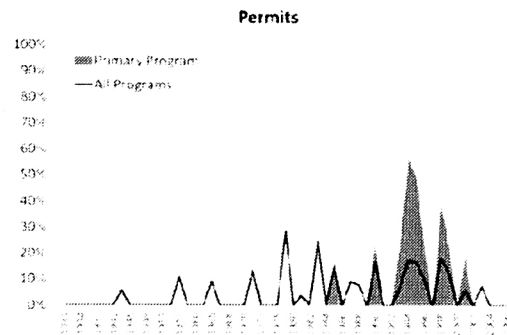
**Figure 13. Information and Planning Percent Use.**



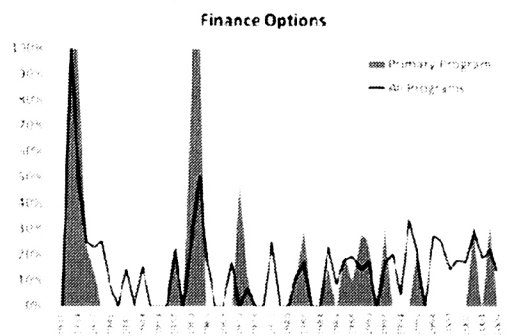
**Figure 15. Monitoring Percent Use.**



**Figure 14. Property Rights Percent Use.**



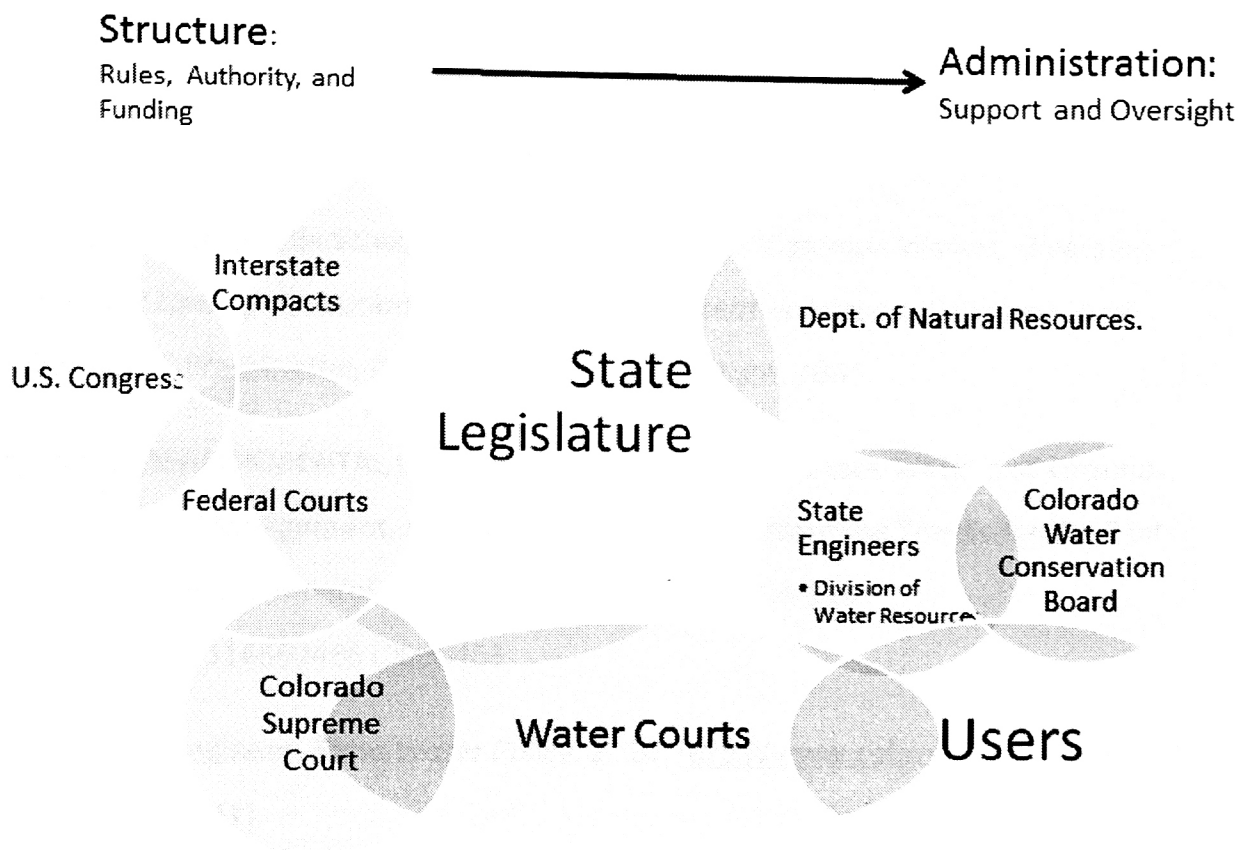
**Figure 16. Permits Percent Use.**



**Figure 17. Finance Percent Use.**

## APPENDIX E

### RELATIONSHIP BETWEEN POLICY VENUES INVOLVED IN COLORADO WATER POLICY, ADMINISTRATION, AND USE



<sup>1</sup>Source: [www.colorado.gov](http://www.colorado.gov) , <http://www.cdphe.state.co.us> , Hundley (1986)

**Figure 18. Colorado Water Policy Venues And Relationship**

### **Bibliography**

- Bates, Sarah F., David H. Getches, Lawrence J. MacDonnell, Charles F. Wilkinson. *"Searching Out the Headwaters: Changes and Rediscovery in Western Water Policy."* Washington, DC: Island Press, 1993.
- Baumgartner, Frank R., and Bryan D. Jones. *Agendas and Instability in American Politics*. 2<sup>nd</sup> ed. Chicago: The University of Chicago Press, 2009
- Blomquist, William, Edella Schlager, and Tanya Heikkila. *"Common Waters, Diverging Streams: Linking Institutions to Water Management in Arizona, California, and Colorado."* Washington, DC: Resources for the Future, 2004.
- Cech, Tom. "ENVIRONMENTAL REVIEWS & CASE STUDIES: Surface Water and Groundwater Interaction, Management, and Conflict in Colorado: Alarming Trends for the 21st Century." *Environmental Practice*, 12, no 4 (2010): 304-315  
doi:10.1017/S1466046610000463
- Colorado State Engineer. *State Water Policy*. 2010. <http://www.colorado.gov> (accessed March 10, 2011).
- Corbridge, James N. and Teresa A. Rice. *"Vranesh's Colorado Water Law: Revised Edition."* Niwot: University of Colorado Press, 1999.
- Frank, Vanessa, Will Paterson, Sam Gallaher, Tanya Heikkila, and Chris Weible. "Exploring 100 Years of Colorado Water Policy: Changes in Policy Issues and Tools". Unpublished manuscript, 2011.
- Gardner, B. Delworth. "The Untried Market Approach to Water Allocation." In *New Courses for the Colorado River*, edited by Gary D. Weatherford and F. Lee Brown, 155-176. Albuquerque: University of New Mexico Press, 1986.



- Getches, David H. and Charles J. Meyers. "The River of Controversy: Persistent Issues." In *New Courses for the Colorado River*, edited by Gary D. Weatherford and F. Lee Brown, 51-86. Albuquerque: University of New Mexico Press, 1986.
- Grigg, Neil S. *"Colorado's Water: Science & Management, History & Politics."* Fort Collins: Aquamedia Publishing, 2003.
- Hobbs, Justice Gregory, Jr. "Colorado Water Law: An Historical Overview." *Water Law Review* 1, no. 1 (1997): 1-120.
- Hobbs, Justice Gregory, Jr. "Colorado's 1969 Adjudication and Administration Act: Settling In." *University of Denver Water Law Review* 3, no.1 (1999): 1-22.
- Hobbs, Justice Gregory, Jr. *Citizens Guide to Colorado Water Law*. ISBN 0-9754075-0-3. Denver: The Colorado Foundation for Water Education. 2004
- Hundley, Norris, Jr. "The West Against Itself: The Colorado River – An Institutional History." In *New Courses for the Colorado River*, edited by Gary D. Weatherford and F. Lee Brown, 9-49. Albuquerque: University of New Mexico Press, 1986.
- Ingram, Helen M., *"Water Politics: Continuity and Change."* Albuquerque: University of New Mexico Press, 1990.
- Kneese, Allen V. and Gilbert Bonem. "Hypothetical Shocks to Water Allocation Institutions in the Colorado Basin" In *New Courses for the Colorado River*, edited by Gary D. Weatherford and F. Lee Brown, 87-138. Albuquerque: University of New Mexico Press, 1986.
- Nohrstedt, Daniel. "Explaining Policy Change in Contested Subsystems: A Stakeholder Analysis of Swedish Signals Intelligence Policymaking" n.d.

- Pontius, Dale in conjunction with SWCA, Inc. *Colorado River Basin Study: Final Report*. Report to the Western Water Policy Review Advisory Commission, 1997.
- Reisner, Marc and Sarah Bates. *"Overtapped Oasis: Reform or Revolution for Western Water."* Washington D.C.: Island Press. 1990.
- Sabatier, Paul A. "An Advocacy Coalition Framework Of Policy Change And The Role Of Policy-Oriented Learning Therein." *Policy Sciences* no. 21 (1988): 129-168
- Sabatier, Paul A., and Christopher M. Weible. "The Advocacy Coalition Framework: Innovations and Clarifications" In *Theories of the Policy Process*, edited by Paul A. Sabatier, 189-220. Boulder: West View Press, 2007.
- Sabatier, Paul, A., Weible, Christopher, M., and Ficker, Jared. "Eras of Watershed Management in the United States: Implications for Collaborative Watershed Approaches," In *Swimming Upstream: Collaborative Approaches to Watershed Management*. Paul Sabatier et al, eds. Cambridge, MA: MIT Press: 2005
- Salamon, Lester M. "The Tools of Government: A Guide to the New Governance." Edited by Lester M. Salamon with the special assistance of Odus V. Elliot, 1-47. Oxford: Oxford University Press, 2002.
- Schlager, Edella and William Blomquist. *Embracing Watershed Politics*. Boulder: University Press of Colorado, 2008.
- Schneider, Anne and Helen Ingram. "Behavioral Assumptions of Policy Tools." *Journal of Politics* 52 no. 2 (1990): 510-530.
- True, James L., Bryan D. Jones, and Frank R. Baumgartner. "Punctuated-Equilibrium Theory" In *Theories of the Policy Process*, edited by Paul A. Sabatier, 155-187. Boulder: West View Press, 2007.

- U.S. Census Bureau. *State and County Quick Facts*. 2009.  
<http://quickfacts.census.gov/qfd/states/08000.html>. (accessed March 10, 2011).
- Udall, Morris K. Forward to *Water Politics: Continuity and Change*, by Helen M. Ingram v-viii.  
Albuquerque: University of New Mexico Press, 1986.
- Weatherford, Gary D. and F. Lee Brown. "Introduction: A Timely Look at a Timeless River."  
In *New Courses for the Colorado River*, edited by Gary D. Weatherford and F. Lee Brown, 1-7. Albuquerque: University of New Mexico Press, 1986.
- Weible, Christopher M. "Expert-Based Information and Policy Subsystems: A Review and Synthesis." *The Policy Studies Journal*, 36, no. 4 (2008): 615-635.
- Weible, Christopher M., and Paul A. Sabatier. "Coalitions, Science, and Belief Change: Comparing Adversarial and Collaborative Policy Subsystems." *The Policy Studies Journal* 37, no 2 (2009): 195-212.
- Weible, Christopher M., Andrew Pattison, and Paul A. Sabatier. "Harnessing expert-based information for learning and the sustainable management of complex socio-ecological systems." *Environmental Science & Policy* 13, (2010): 522-534.